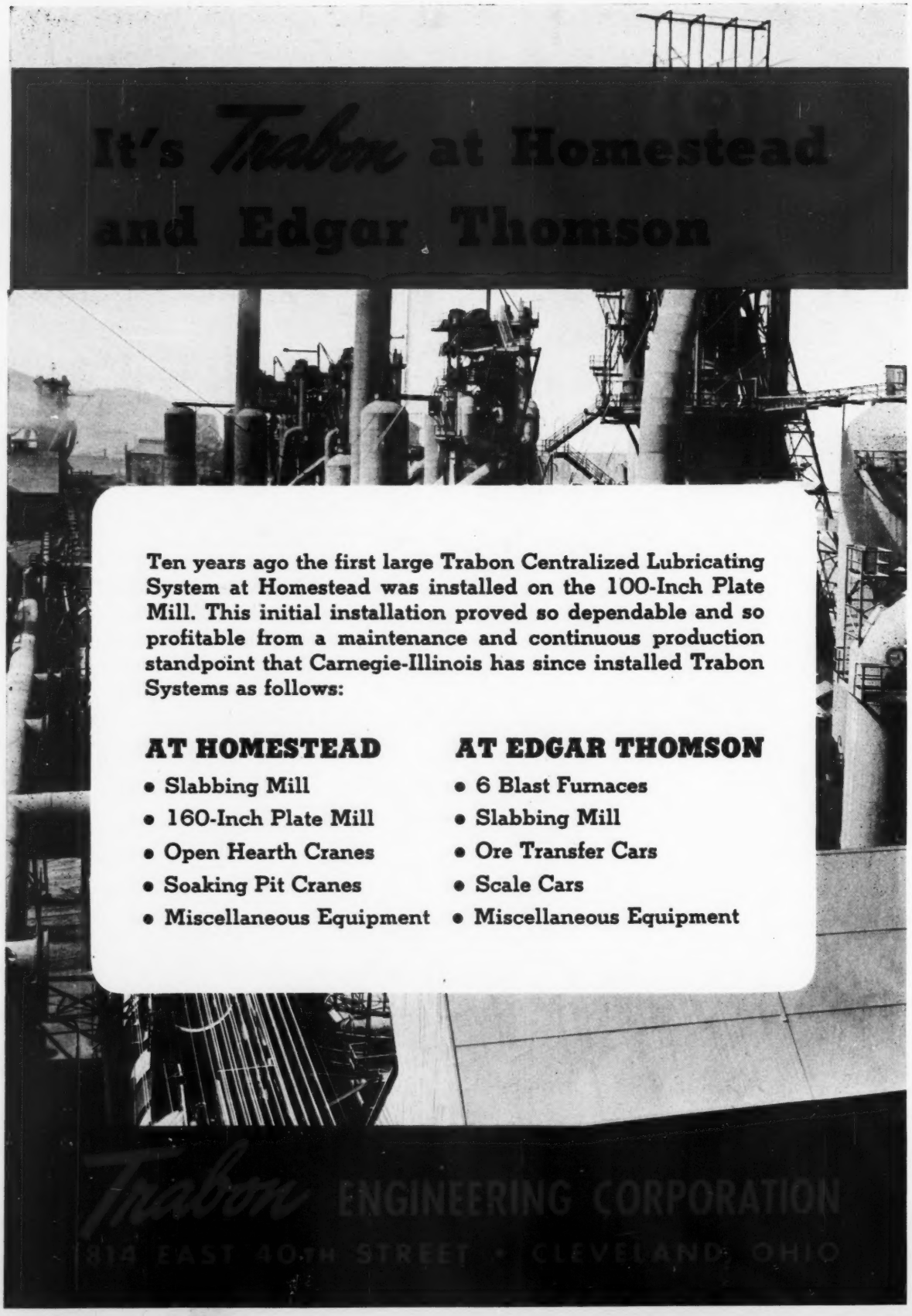
FEBRUARY, 1948
Vol. 4 — No. 1

A·S·L·E

Lubrication ENGINEERING

JOURNAL OF THE AMERICAN SOCIETY OF LUBRICATION ENGINEERS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Advertisers IN THIS ISSUE

Acheson Colloids Corporation	6
Alemite	3
American Cyanamid Company	11
Aro Equipment Corporation, The	5
Bowser, Inc.	1
Brace Engineering Co.	27
Burns Laboratories, Inc.	24
Cincinnati Milling Machine Co.	8
Dow Corning Corporation	33
Farval Corporation, The	Inside Back Cover
Grafo Colloids Corporation	40
Hodson Corporation, The	Back Cover
Honan-Crane Corp.	9
Houghton, E. F. & Co.	10
Lincoln Engineering Co.	12
Madison-Kipp Corporation	7
Norgren Co., C. A.	27
Quaker State Oil Refining Corp.	31
Sinclair Refining Company	35
Stuart, D. A., Oil Co., Ltd.	2
Trabon Engineering Corporation	Inside Front Cover
Trico Fuse Manufacturing Company	17
Winslow Engineering Company	4

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VOL. 4 FEBRUARY, 1948 NO. 1

In This Issue

The Editor's Page ... 13

A Look Inside the Mechanical Seal and Design Consideration—by Carl E. Schmitz ... 14

The Evaluation of Cutting Fluids in Laboratory Equipment—by L. H. Sudholz ... 18

Lubrication of Industrial Gear Drives—by F. Richardz ... 25

The Evaluation of Motor Oils by the Underwood Oxidation Test—by L. H. Stranahan ... 28

Lube Spots—Feature ... 32

New Books ... 33

News of Industry and Personnel ... 34

New Products ... 35

News of the Sections ... 36

Section Officers and Committees ... 37

Patent Abstracts, Oils and Lubricants ... 39

Advertiser's Index ... 1

LUBRICATION ENGINEERING
Official Publication of the American Society of Lubrication Engineers
343 SOUTH DEARBORN ST., CHICAGO 4, ILL.

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Northwestern Technological Institute, Evanston, Ill.

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Price: Subscription price, $3.00 per year. Single copies, 75c each, postpaid.

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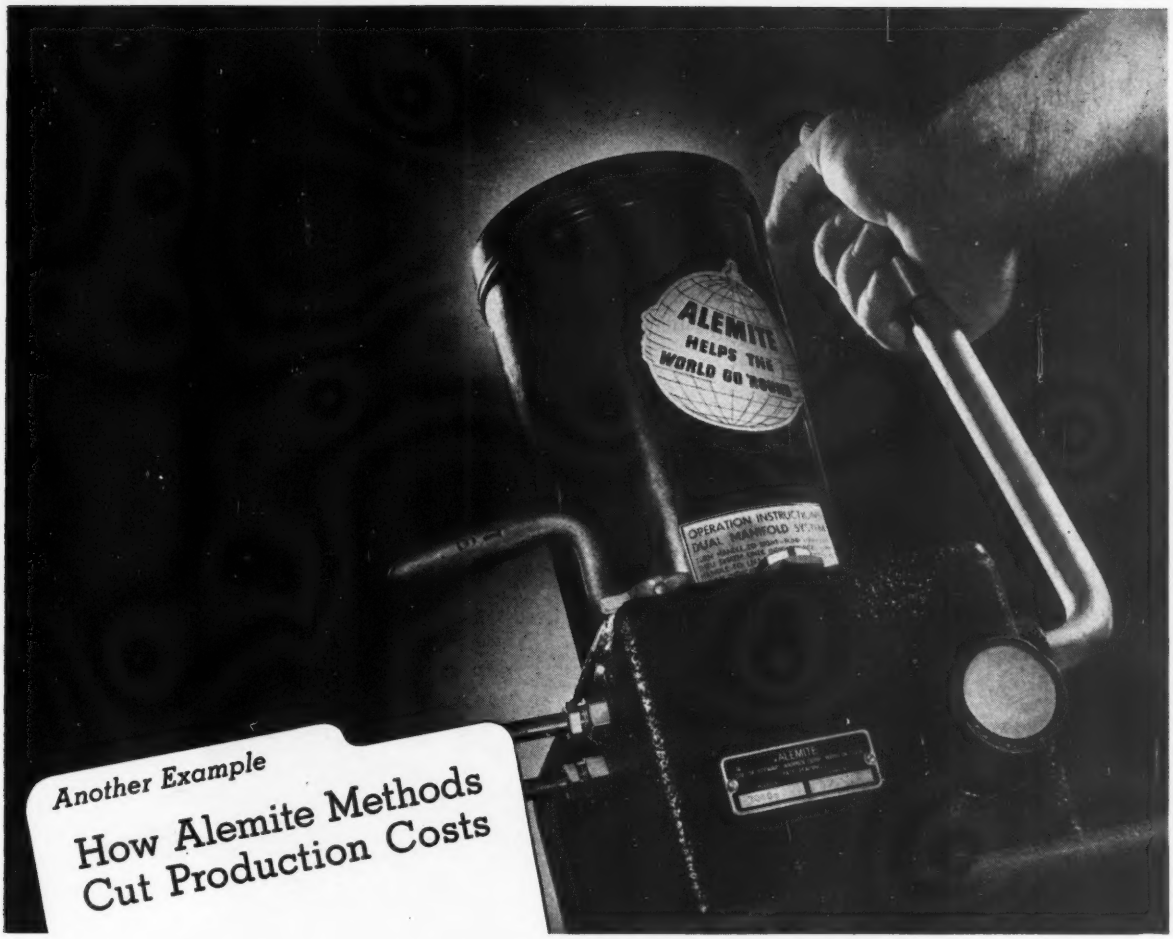
Address correspondence regarding contents, manuscripts, etc., to the editor at Northwestern Technological Institute, Evanston, Ill.
Inquiries regarding advertising space and rates should be addressed to W. F. Leonard, Lubrication Engineering, 343 S. Dearborn St., Chicago 4, Ill.



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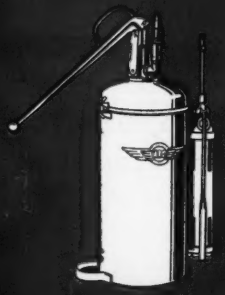

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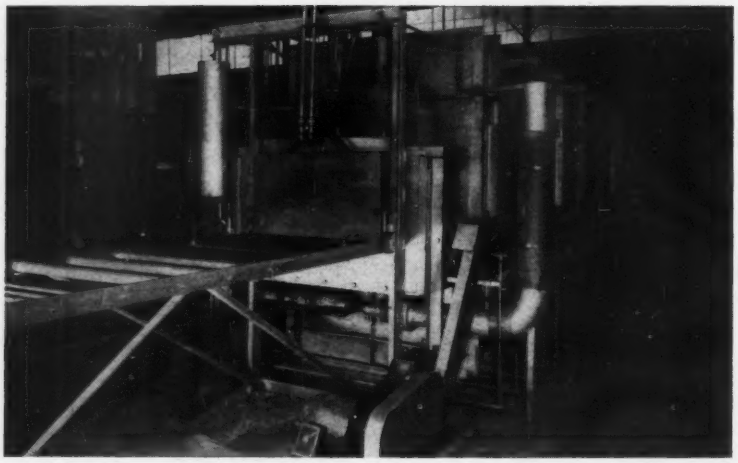

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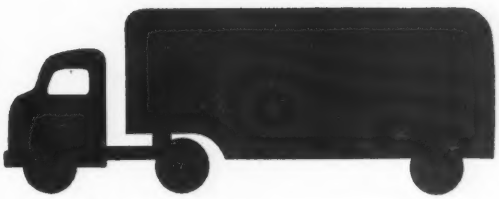

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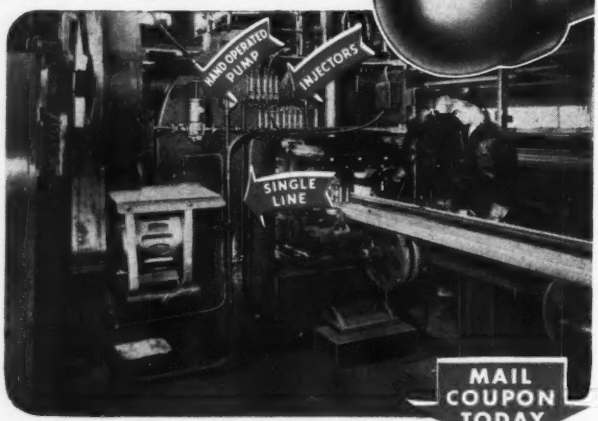

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THE EDITOR'S PAGE

EDITORIAL

THE year 1948 started out with the usual crop of bad news and good. On the bad news side, we have shortages, rising prices, new sets of wage demands and the continuing cold war with bad international relations. On the good side appear the possibility that some of the shortages are becoming less short, rising prices may soon pass their peak, and a successful year for technological advancement has just been completed.

The fuel situation, particularly from the viewpoint of petroleum fuels, is still critical with supply not quite up to demand. This will probably be true clear through the heating season. Steel will still be short and will restrict manufactured production.

Building materials are starting to ease up, but are still very tight. However, the public is beginning to gain confidence in this respect as a large amount of new construction is being started in various parts of the country. Let us all hope that the situation will not get to the point that government controls will have to be reapplied. These are relatively easy to put on, but very difficult to lose.

Engineering progress had an interesting year in 1947 with design treading close on the heels of metallurgical advance. For the first time commercial equipment in steam turbines and superheaters has been designed for 1050 F. This represents a real step forward in the field of equipment design for long life, as the creep problem for metals at such temperatures must be carefully considered. At 1050 F there is also some breakdown of the steam itself into its constituent elements and this must also be considered in high-temperature plant design. For short-life equipment, gas turbine blades have been operated using 1500 F gases but permanent long-life design is not even near this point. Certain of the so-called super-alloys using cobalt, chromium and nickel develop strengths reaching 25,000 pounds per square inch at 1500 F. This sounds low in terms of values in excess of 100,000 pounds per square inch at room temperatures, but in truth it represents an astounding advance in metallurgical progress.

Building design has been going *up* as well. In Des Moines, Iowa, a radio tower 1530 feet high is being built. This is 280 feet taller than the Empire State Building and is nearly three times higher than the Washington Monument. It is being constructed to permit a larger radius of coverage for a frequency modulation transmitting station.

In lubrication mention should be made of the many outstanding advances in blending and refining, and the outstanding progress which has been made toward development of silicone lubricants for special applications, particularly at high temperatures.

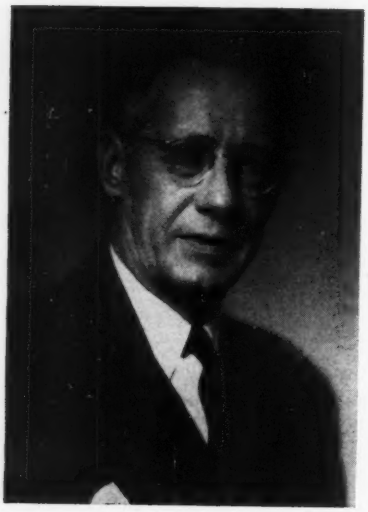
We can all look forward to the new year with every expectation of seeing continued progress in engineering and science. But as engineering processes often need a catalyst or missing ingredient to make them work; so do processes in life. The following story, which has its origin lost in the past, teaches us such a lesson.

An Indian merchant willed his herd of elephants to three sons. The first was to receive one-half of the herd, the second one-third of the herd and the third one-ninth of the herd. At the time of his death there were seventeen elephants in the herd, and a noisy squabble resulted as to how the impossible division could be made. An uncle, who had a reputation for great wisdom, was asked to settle the difficulty. After hearing the details, he left the sons without comment, saying only that he would return. Shortly afterwards he came back leading one of his own elephants. He opened the gate and added his elephant to the herd, saying, "Nephews, I am giving you my elephant if you need it." They were overjoyed and immediately made their division, the first son receiving his half, nine elephants; the second son receiving his third, six elephants; and the third son receiving his ninth, two elephants. After these elephants had been led away, the uncle walked into the yard and calmly led the remaining elephant home.

Should we call the eighteenth elephant a pachyderm catalyst, or can you think of a better name?

B. H. JENNINGS, *Editor.*

*A Look Inside the Mechanical Seal and Design Consideration



By CARL E. SCHMITZ

Crane Packing Company
Vice President and Director of Engineering

Mr. Schmitz writes from his wide experience as a design engineer. After his graduation from the Joseph P. Branch School of Marine Engineering, he took special work at the U. of Illinois. He is a member of many engineering societies and Vice-Chairman of the Chicago Section of A.S.L.E. Formerly chief engineer, he is now Vice-President and Director of Engineering of the Crane Packing Company of Chicago.

AS a rather general statement, all mechanical seals are basically composed of a rotating and stationary element and some means of keeping them in contact. As the number of kinds of seals and their utility is appreciated by mechanical and lubricating engineers, the number of papers and articles on the subject is increasing. The need for a better understanding of construction and application of this important mechanical device is becoming keener, and itis to construction and application that I especially want to call your attention.

First, let us consider the vital matter of construction. "A Look Inside The Seal" we find these important factors. 1. Flexibility; 2. Surface finish of mating faces; 3. Positive driving means; 4. Metallurgy; 5. Engineering, Laboratory testing, and Research. These factors are not necessarily arranged in their order of importance. Each is an important factor all of which, properly coordinated, go to make the most successful seal for the widest range of applications.

Since every mechanical device has manufacturing tolerance, and likewise the seal itself must have tolerances, it would immediately become evident that *flexibility* is an important consideration. It is impractical to hold axial tolerances below plus or minus .005 and this even in so called precision equipment. Many high production products run as high as plus or minus .020. Thus you can readily see that when initially installed a good seal must be able to compensate for this radial movement to which must be added the overall length tolerances of the seal manufacturer, which on high production items is impractical to hold closer than plus or minus .015. It is immediately evident that one might run into a condition of having to meet a total variation of plus or minus .035, and this is a conservative figure. Further, the seal must be flexible enough to compensate for wear at the contacting faces. Since wear is somewhat unpredictable, varying under several conditions of service, it is immediately evident that perhaps of highest importanse in good seal construction is *flexibility*. To assure the maximum in life is made provision for wear up to about .090, feeling that when that much wear occurs the seal has lost its utility and should be replaced.

As an example of just what a good seal might be called upon to do, a manufacturer contemplating the use of seals made an experimental hook-up and when the unit was run, struck the shaft with a hammer and threw out any seal that leaked under this test. The radial movement of the shaft when the hammer blow fell was in the neighborhood of .035. Needless to say, many seal designers and manufacturers had their products thrown out. This may seem a hard and unjustifiable test. In many mechanisms the shock and work load conditions are such as to impose considerable axial shock and movement.

A spring or series of springs is usually employed to take up axial movement. High initial loading will usually result in excessive wear and heating of the seal faces. The flexing members must, therefore, be so designed as to require low pressure to assure proper movement under installation and operating conditions. Materials used must be such that they will not "work harden" and crystallize as do so often thin metallic structures.

We find that especially compounded synthetic rubbers provide about the best flexing members. While other materials have been used, they are frequently discarded as not too satisfactory insofar as life and general good service are concerned. The material employed must also withstand flaxing action in a radial direction which further complicates the problem. In addi-

* Presented before the Chicago Section of A. S. L. E., May, 1947.

tion to having a flexing member that will withstand considerable movement with the least possible effort, it is further necessary that the component parts of a good seal must be so designed as to permit the flexing member to move radially and axially freely and under all conditions of operation.

The seat, usually stationary, should be so mounted in flexible materials that tightening of bolts or glands can in no way distort the closely lapped faces. It may strike you as unusual but it is true that relatively heavy sections of iron or steel may be distorted in one's hands so as to throw a closely lapped face considerably off flatness requirements in good seal practice. Some jobs are still designed to use so called solid end plates, but these are rapidly being discarded in favor of the floating seat. Floating, as it does entirely in a synthetic resilient ring, imposes no detrimental stresses upon the flatness requirement and further permits ready replacement at a minimum cost. Such seats are easily adaptable to most mechanical devices and permit the seal user to purchase the whole unit from one source. The progressive seal manufacturer now markets a complete unit including a factory lapped and inspected stationary seat and rotating seal washer, and all having the required *flexibility* to meet the wide variety of operating conditions encountered.

Surface Finish of Mating Faces

Much has been written and said about surface finishes, first perhaps in regard to ordinary bearings where conditions are somewhat easier than encountered with seal faces. In one instance the rolling action of the shaft in the journal tends to roll in and on the lubricant whereas seal faces are usually set in vertical plane and present a somewhat more difficult problem insofar as introducing proper lubricating films. Before the art of lapping and obtaining highly polished and parallel faces was commercially feasible, seal manufacturers used to ship seals and include with them a container of abrasive with instructions to set up the seal and put the abrasive paste between the faces and thus wear them in. I understand that one seal manufacturer follows this practice even today. In my opinion, such practice today is inconceivable and inconsistent with the trend of the times. The manufacturer making such a recommendation has apparently never told the user how to remove the abrasive material from between the faces once its mission has been accomplished, nor has any explanation been given as to the effect of this material entering the oil or product handled. High surface finish eliminates the old so called "break-in" period, permits more efficient and effective lubrication by developing conditions that will eliminate oil film failure by rupture through surface to surface contact. Costly experimentation and much research was necessary to work out the proper equipment. Nor was the selection of equipment all of the problem. Technique of handling and conditioning of lapping fluids—stress relieving and product handling were also to be worked out to make the process adaptable to high production requirements. There are two main objectives in the production of a good mating or bearing surface. The one, "Metallurgical," is to remove the defective metal at the surface, previously produced by the shaping or dimensioning operation, and expose the true crystal of the material actually bisected so as to have an extremely fine plane surface; and the other, "Geometrical," is to remove the hills and valleys (scratches and/or flaws) and by the laws of physics to generate a true and smooth surface which will eliminate the danger of film rupture and material to material contact that only lead to increased friction, wear, and failure. The following test data compiled by the Massachusetts Institute of Technology may be of interest to lubricating engineers. This test was run to demonstrate the failure point of load carrying capacity of the oil in a conventional bearing. The oil used had a viscosity of 150 seconds at 110 F and was grade M.S.782. The shaft speed was 950 rpm. With a finish of from 22 to 28 micro inches the failure point was an average of 71 pounds per square inch. With a finish of from 8 to 10 micro inches the failure point was 153 pounds average. With a finish of from 0 to 2 micro inches the failure point was 217 pounds average. While these figures may not be wholly applicable to vertically running faces, they are at least indicative of what takes place with regard to seal faces.

It was early discovered that R.M.S. specification, while important, was not the only problem to be considered. Flatness of the whole surface area is also important and to this end optical flat inspection was instituted. Surface flatness of from one to two light bands are required and regularly produced by high production methods. Many scientific and engineering organizations are doing work on surface finished. Among those interested and working with the problem are:

National Bureau of Standards
Society of Automotive Engineers
American Society of Mechanical Engineers
National Aircraft Standards Committee

and others.

Equipment to evaluate surface conditions is being improved and made available to those interested in precision manufacturing. Principal among the manufacturers of such equipment are:

Physicists Research Company
Brush Development Company
Comtor Company

and the several manufacturers of Optical Flats. The Crane Packing Company, whom I represent, inspect all lapped surfaces manufactured by them with optical flats. We do not permit spot checks. 100% inspection of each and every part that is manufactured thus assures users of our products the best possible in the way of precision faces, optically flat, smooth, and thus designed to give the maximum of efficient long life.

Lately some experimental work is being done with so called liquid honing whereby abrasives ranging from 400 to 600 mesh are forced against the bearing faces at extremely high velocities. It is yet too early to predict whether or not this surface treatment will be beneficial insofar as seal construction and production are concerned.

Positive Driving Means

A means of so driving the seal that none of the torque load can or is imposed on the flexing member, whether it be of metallic or synthetic materials, is important. The washer or usually moving face may require considerable break out torque, and if the flexing member is called upon to carry any part of this load or the running load it soon crystallizes, especially if the membrance is metallic. If of synthetic rubber, internal abrasion and constant flexing causes the material to thus rapidly break down and seal failure of course results.

Good practice requires that the flexing member must be so constructed to permit close contact of the faces to compensate for wear. A positive driving means permits the use of relatively low spring loading which

again is an important factor in seal life. High P.S.I. loading tends to exclude the thin lubricating film. The manufacturers of many seals on the market today attempt to use high spring pressure and thus impose the driving torque load on the spring. This frequently results in chattering, poor seal life, and general dissatisfaction,

Metallurgy

Good general metallurgy necessitates selection of proper materials to withstand the medium in which the seal operates. This problem is not too severe in most industrial equipment, brass and steel being most commonly used and serve well in most oils, water, greases, and hydrocarbon distallates. Seals are finding an ever increasing use in the highly complex chemical industries where corrosion is a common problem. In these instances stainless steel, usually of the 316 variety, is commonly used. However, in considering seal metallurgy of highest importance is the washer and seat material combinations. For most industrial installations a good grade of cast iron with carbon or synthetic resin bonded graphite and metal combinations make for long satisfactory life. Such combinations are widely used in refrigeration service and are well suited for relatively high speed industrial applications wherein the principal problem is to hold a lubricating medium and perhaps gases such as are commonly employed in the refrigeration field. Carbon and bronze serve well for problems involving water. Ni-Resist and Meehanite run well with carbon combinations in certain types of installations. In highly specialized services, Stellite— 52/100 Steel— ceramics—and a host of other materials are run in various combinations which testing and field service demonstrate are best suited. As the need for and use of seals continues to increase, new combinations of materials are being tried. Almost every known combination of metal, carbon, and ceramic products are experimented with and then used in actual installations after research and laboratory tests reveal that there is a possibility of such materials being employed to the advantage of the seal user.

Engineering—Laboratory Testing—and Research

A seal can be only as good as the engineering, testing, and research that goes into it. Engineering involves not only applications but structural designs as well. No reference work being available, all developments must go through extensive laboratory testing to prove or disprove their utility. Let us take for example the matter of mating face width. A start is made with what seems theoretically practical and then by actual testing various combinations with wider and narrower faces, each one, after the original idea, must be tried until at last the most desirable is selected for operation in a given material at selected speed, temperature, and pressure. Handling another material may so change the results that another complete set of tests are necessary.

We employ many types of equipment so that a good variety of tests can be conducted and thus establish the most practical unit for a wide variety of services.

In the test laboratory are available a host of units that permit testing under almost any condition of speed, temperature, and pressure. Each test is carefully recorded and the seal so tested, carefully catalogued and available for inspection at some later date should it be further necessary.

Our engineering organization is comprised of those who we have especially trained in making applications to a wide variety of problems which are submitted to us. Some are specialists in application principles and others are specialists in the art of design for development of the various parts that go to comprise the seal itself.

Supporting the Engineering Department and Testing Laboratory is a completely equipped Research Department. Here are analyzed various materials and standards established for many of the component parts. The research organization is continually checking various materials to be handled and assist in selecting best suited materials for any given problem.

Summarizing now, "A Look Inside The Seal" calls attention to these outstanding requirements for assurance of good service and a product worthy of your consideration;

1. Flexibility
2. Surface finish of mating faces
3. Positive driving means
4. Metallurgy
5. Engineering, Laboratory testing, and Research

The progressive manufacturer offers you no less in attempting to solve your seal problem.

We shall now consider the problem of application. Nearly always the prospective user comes to the manufacturer with design of equipment already worked out. Space requirements held to the very minimum, this usually based on some preconceived idea of what ought to do the job. After initial tests are run the equipment selected for solution of the problem falls short of the needs, and a solution must be sought usually hedged with this statement. "Anything used must fit into the existing space", which we usually find limited and too small in both axial and radial dimensional requirements for application of a good seal.

Engineers having sealing problems would do well to submit the problem in the early design stages so as to avoid redesign and costly later changes. In a great many instances considerable savings can be had by embodying construction applicable and already widely used when seals are employed.

Of special interest to lubricating engineers and the progressive equipment designer is the use of their combined talents along with the design engineer's knowledge in the early development stages, since a properly sealed unit may be constructed to use;

1. A more expensive lubricant better suited to the problem and employ seals to prevent loss of the lubricant.
2. A lubricant of lower viscosity since it can be satisfactorily held by seals.
3. Eliminate costly filtering and accompanying equipment since seals prevent contamination of oil in the system.

Applications have been worked out for hundreds of appliances and layouts are available without cost on the part of the potential seal user. However, to obtain the most satisfactory performance the seal must be carefully selected and applied and when so used will give years of satisfactory service without addition or adjustment.

A big application factor in using seals is that they entirely eliminate the human element once properly installed. They require no adjustment and can be forgotten.

In making applications care should be exercised to insure the lubricant contacting the seal faces. Early packing designs employed many ingenious devices to keep the lubricant or material sealed away from the gland. In applying seals the exact opposite should be

employed. Higher oil levels should and can be maintained and the manufacturer who uses seals intelligently can point out to the customer considerable savings in maintenance and replacement of lubricating means.

The designer must keep in mind that shaft rigidity is important and deflection kept to the minimum, since various changes take place in iron and steel parts as load is applied or taken off. If the load were steady, deflection would not present too great a problem but it is the constant changing with operating conditions that complicates matters. Proper alignment makes for better and longer equipment life. Its importance cannot be disregarded when applying seals.

If high operating pressure is encountered, the balanced seal can be used to advantage. This type of seal is so constructed that the seat and washer faces are in pressure balance. The forces within the seal cavity are so disposed as to balance themselves and thus the usual spring loading is only necessary to compensate for wear. Longer life, less heat generation, and lower power requirements are the result of this development in seal construction.

Double seals are often advantageously applied, especially to overcome corrosion problems or when materials containing large percentages of solids are handled. Some lubricating medium must be circulated between the double seals so as to provide proper lubrication for the seal faces and to further carry away such heat as is generated. These installations are widely used in paper mills, chemical plants, or when handling highly irritating gases. On such installations the lubrication engineer is called upon to select the oil or material circulated through the seal cavity.

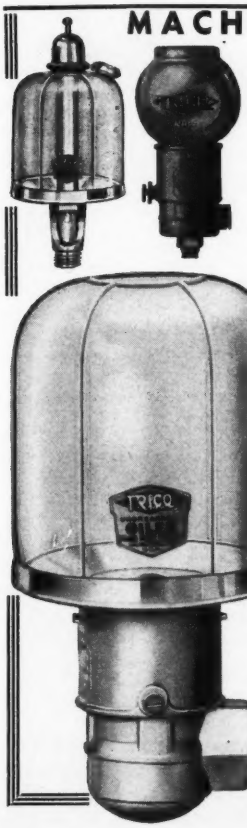
Single lubricated face seals are applied to jobs where the pressures are usually low, and the material handled has poor lubricating qualities or contains materials that might be detrimental to the highly polished faces. The lubricating material is introduced through the stationary seat. The seat having a series of holes leading from the face to the lubricating material supply labyrinth.

Lubrication is applied usually by means of a spring loaded grease cup using light especially designed greases or oil is introduced by a circulating pump or from a gravity storage supply, whichever is indicated to be the best based on laboratory and field tests.

Summarizing

Application of the proper seal for the job is the answer to successful performance. Submit your application problem to a qualified manufacturer before you are too far advanced with construction details. Follow closely layout submitted and approved for the particular job under consideration and assure a successful seal application. Every engineering-minded individual, whether he be lubricating, mechanical, automotive, or engineer of any other classification, can today find a seal for any problem he might have in mind. Representing perhaps the largest seal manufacturer in the business today, we will welcome an opportunity to work with you.

MACHINES *Serve* BETTER . . . *Last* LONGER
WHEN LUBRICATED WITH



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The Evaluation of Cutting Fluids in Laboratory Equipment*

By L. H. SUDHOLZ
Technical Service Dept., Socony-Vacuum Oil Co., Inc.

DURING the past few years, especially while the high production schedules were in effect during the war, a great number of consumers of cutting fluids became aware of the fact that all cutting oils were not alike and that appreciable improvements in performance could be effected by choice of the optimum product for the particular application. These improvements are mainly evidenced as increased tool life, decreased tool wear, improved finish and in some cases, greater dimensional accuracy. Because of the recognition of possible increased production, greater interest has been shown in field tests of cutting oils. However, since all of the variables are not always readily controlled under field conditions, much attention has been focused upon laboratory evaluation.

Because of the many variables involved, metal cutting operations are quite complex and hence, the evaluation of cutting fluids, is not a simple subject. Accordingly, an attempt will be made to show that the ordinary physical and chemical tests, and even some film strength tests, which are sometimes conducted, do not give even approximate indications of the performance characteristics of cutting fluids. This is undoubtedly due to the fact that different temperatures and pressures exist at various points on the tool. Furthermore, these conditions can vary appreciably, dependent upon the nature of the metal being cut, feeds, speeds, etc.

Therefore, in the evalution of cutting fluids in laboratory equipment, these variables are very carefully controlled. They include composition and hardness of the metal being machined and of the cutting tools, tool angles, feeds, speeds, and the temperature and flow of cutting fluid. For all practical purposes, the only variable under these conditions is the cutting fluid.

In order to understand the many factors involved in the evaluation of cutting fluids, the theory of metal cutting should be reviewed briefly.

Figure 1 shows a single point turning tool, the side and back rake angles, and end and side clearance angles being indicated. The angles usually employed are dependent upon the type of metal being machined. In general, the soft, draggy metals should be machined with sharper angles than the hard, clean cutting metals.

In Figure 2 a simple turning operation with a single point tool is shown with the three different pressures acting on the three different areas of the tool being indicated. The variable lip pressure is produced by the irregular flow of metal. The pressure at the nose of the tool is caused by the deflection of the tool that results from the variable lip pressure. The pressure on the side of the tool is due to the rate of feed.

There are a number of theories regarding the manner in which the cutting oil is introduced to these high pressure areas. In our opinion the most logical one seems to be that the microscopic vibrations of the tool create minute openings which admit the cutting fluid. At any rate, there is evidence that the cutting fluid does reach the high pressure area on the face of the tool.

As illustrated in Figure 3, when soft, draggy metals are machined, there is always an accumulation of structureless material on the lip of the tool, at the cutting edge. This material has been scraped off the work piece by the cutting edge and is known as the built-up edge. It is a semi-mobile mass between the chip and tool and alternately accumulates and sloughs away. The build-up is, of course, subjected to the cutting pressures and temperatures encountered, and under certain conditions it may actually weld to the tool, as is shown in Figure 4.

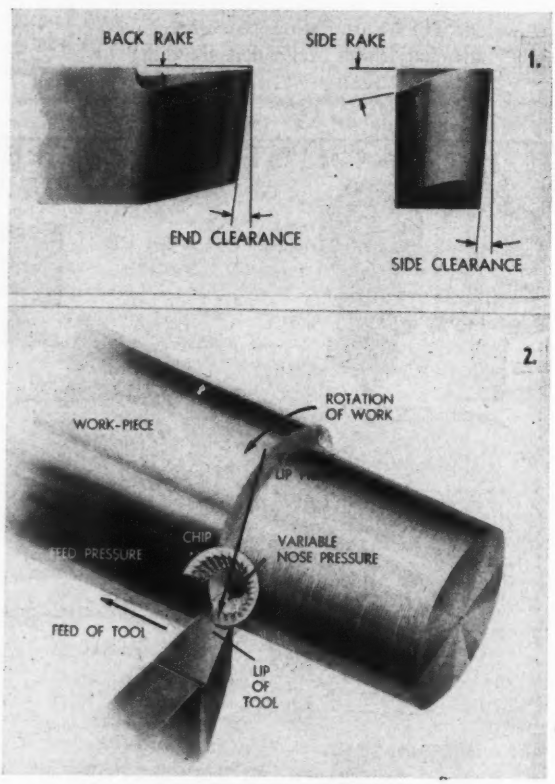


Fig. 1. Tool Angles
Fig. 2. Cutting Pressures

The sloughing of the built-up edge is indicated in Figure 5. This shows the underside of two chips, the lower produced in the machining of a clean cutting material and the upper, in the machining of a soft,

* Presented before Milwaukee Section of A.S.L.E. April 21, 1947 by

ductile steel. The former is smooth and shows no build-up while the latter indicates the accumulation of build-up that is periodically sloughed away with the chip.

As noted in Figure 6, the accumulation of appreciable build-up which occurs in machining soft, draggy metals, localizes the rubbing action of the chip at an appreciable distance from the cutting edge of the tool. Maximum tool temperature is, accordingly, removed from the cutting edge and the resistance of the cutting edge to wear and breakdown is improved. This condition tends toward long tool life.

In the machining of clean cutting metals, as shown in Figure 7, the lack of appreciable build-up tends to localize the rubbing action of the chip at, or nearer to the cutting edge of the tool. This brings the maximum tool temperature close to the cutting edge, decreasing its resistance to wear and breakdown. This condition tends toward short tool life.

Obviously, it is undesirable that an excessive built-up edge accumulate more rapidly than it can slough off with the chip, since then it tends to slough between the nose of the tool and the work-piece, especially if the nose is slightly worn. This tends to produce a rough finish.

The mechanism of metal cutting can be further illustrated in a number of views of actual singe point cutting tools. Figure 8 shows a cutting tool, the face of which has been honed to present a smooth surface to the chip. This tends toward lower friction and hence lower temperature and increased tool life. Honing of the cutting tool at frequent intervals will further increase tool life.

Figure 9 illustrates the surface of the face of a cutting tool produced by grinding. The abrasive marks are clearly visible and it is obvious that greater friction between the chip and the tool will occur, the tendency toward welding will be increased and tool life will be shortened.

The actual build-up, welded at the cutting edge of a tool is illustrated in Figure 10. This is typical of that produced in the machining of a soft, ductile steel. In most cases, the build- up is semi-mobile and is not welded to the tool.

When appreciable build-up exists at the cutting edge the chip contacts the tool at the point removed from the cutting edge, resultant wear forming a crater at that point as shown in Figure 11. Tool life is usually prolonged, tool failure not occurring until the crater finally reaches the cutting edge.

Figure 12 shows imminent tool failure, the wear occurring on the nose and face of the tool approaching the cutting edge. With continued use, complete breakdown will occur very shortly, necessitating considerable grinding to recondition the tool. Since excessive tool grinding represents an expensive practice, tools should be reconditioned before complete failure occurs.

Actual tool failure is indicated in Figure 13 where the wear on the nose and the face of the tool have proceded to the point where dimensions can no longer be maintained, the original cutting edge having entirely disappeared.

Before discussing the evaluation of cutting fluids, it might be in order to outline briefly their required characteristics. These are as follows:

1. Adequate Pressure Resistance

   This minimizes the friction between the chip and the face of the tool, and prevents periodic seizure. This results in reducing wear and cratering.

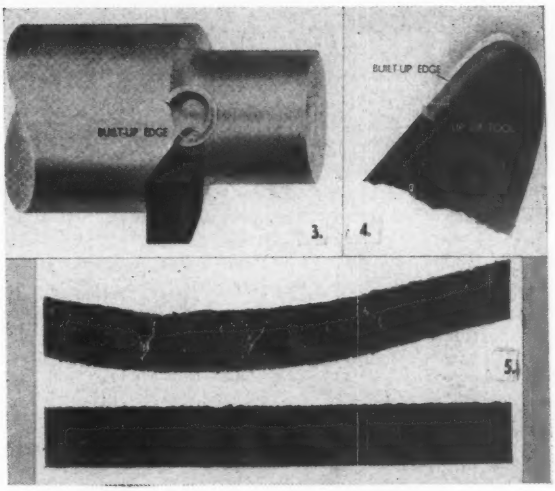


Fig. 3. Build-up in Machining Operation
Fig. 4. Built-up Edge on Single Point Tool
Fig. 5. Sloughing of Built-up Edge

RUBBING ACTION LOCALIZED AWAY FROM CUTTING EDGE
IDLE BUILT-UP EDGE PROTECTS CUTTING EDGE
DUCTILE WORK-PIECE
TOOL
RUBBING ACTION LOCALIZED NEAR CUTTING EDGE
SMALL BUILT-UP EDGE GIVES LITTLE PROTECTION TO CUTTING EDGE
SEMI-BRITTLE WORK-PIECE
TOOL

Fig. 6. Effect of Build-up on Tool Life
Fig. 7. Effect of Negligible Build-up on Tool Life

2. Proper Anti Weld

   By maintaining a satisfactory amount of build-up, the cutting edge is protected and the rubbing action of the chip is localized away from the cutting edge. An excessive accumulation of build-up on the lip of the cutting tool is prevented so that the built-up edge is mobile and does not slough between the tool and the work and adversely affect the finish.

3. Adequate Lubricity

   This minimizes the development of frictional heat, and hence wear, in the boundary area, and thus assists in maintaining dimension and finish.

4. Maximum Cooling Ability

   By carrying away as much heat as possible and maintaining low tool temperature, resultant tool life is prolonged. Dimensional accuracy of the work is also maintained.

The cutting fluids normally employed in the machining of metals may be broadly classified as non-soluble and soluble. The former are blends of mineral oils plus other materials and are not emulsifiable with water. The latter are, of course, dispersible and are used in the form of emulsions.

Before discussing the laboratory tests which are normally conducted on cutting fluids, the general composition of typical products should be reviewed.

Non-soluble cutting fluids may consist of mineral oils, fatty oils, or modifications thereof plus compounds. The basic materials used in these combinations are as follows:

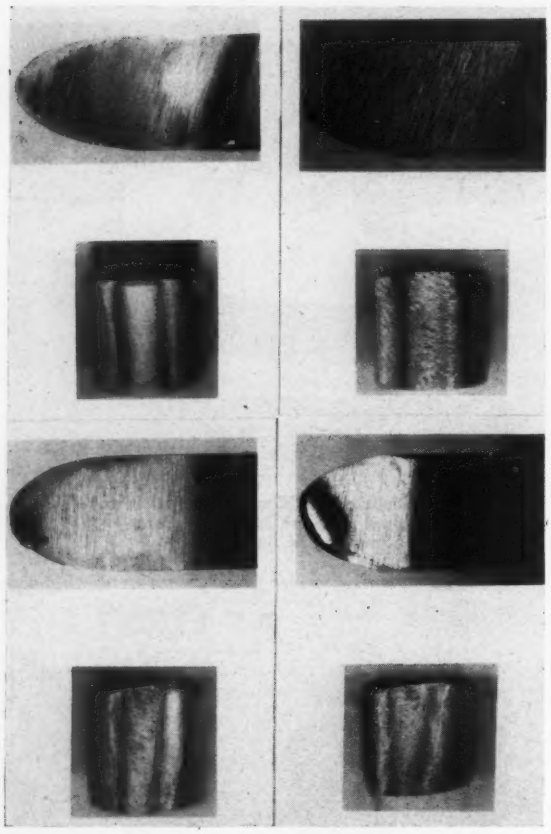


Fig. 8. Honed Face of Tool

Fig. 9. Ground Face of Tool

Fig. 10. Build-up at Cutting Edge

Fig. 11. Cratering on Tool Face

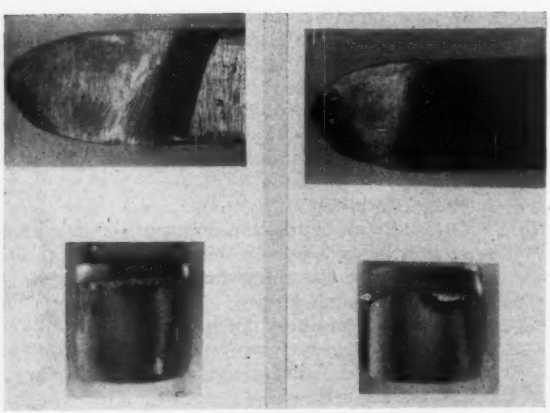


Fig. 12. Imminent Tool Failure

Fig. 13. Tool Failure

1. Mineral Oils
   - A. Straight
   - B. Sulfurized
   - C. Chlorinated
   - D. Sulpho-chlorinated
2. Fatty Oils
   - A. Straight
   - B. Sulfurized
   - C. Chlorinated
   - D. Sulpho-chlorinated
3. Compounds containing Sulfur, Chlorine, Phosphorus, etc.

Obviously there is a large variety of combinations of the above materials which could be employed in the blending of cutting oils.

The physical and chemical tests normally conducted on non-soluble cutting fluids include the following:

Physical Tests

1. Gravity, °API
2. Flash, C.O.C., F.
3. Pour, °F.
4. Viscosity @ 100 F.
5. Color, A. S. T. M.
6. Odor
7. Copper Corrosion Test (3 hrs. @ 212 F.)

Chemical Tests

1. Sulfur (Total), %
2. Sulfur (Active), %
3. Chlorine, %
4. Phosphorus, %
5. Fatty Material, %
6 Nature of Fatty Material

The gravity of a cutting oil is of little significance if the product is a blend of several oils, bases or other additives. If it consists largely of a single mineral oil or a sulfurized mineral oil, some indication of the source might be obtained from this determination.

The flash point is a rough indication of the volatility of the oil. Obviously the flash point should be sufficiently high so that no appreciable fire hazard is presented during the machining operation. The minimum flash point of low viscosity oils used in the machining of aluminum, magnesium, and their alloys is usually about 280 F.

To the average plant man, the pour point merely denotes the temperature at which the oil will flow from the barrel.

The viscosity of the cutting oil is one of the most

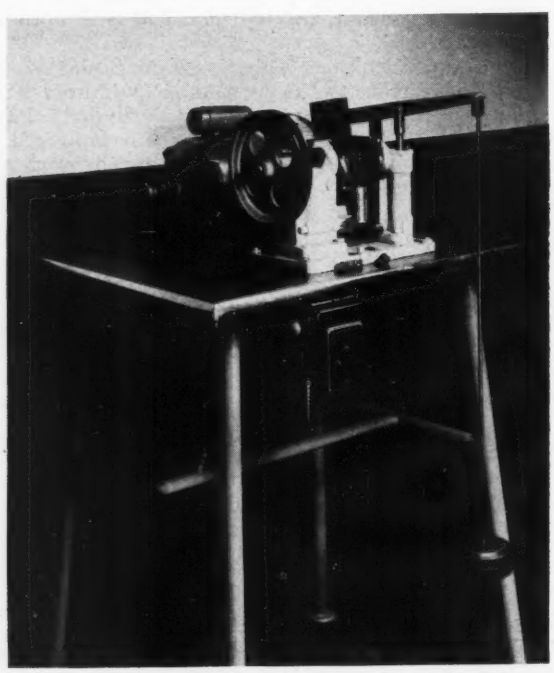


Fig. 14. Almen Extreme Pressure Lubricant Tester

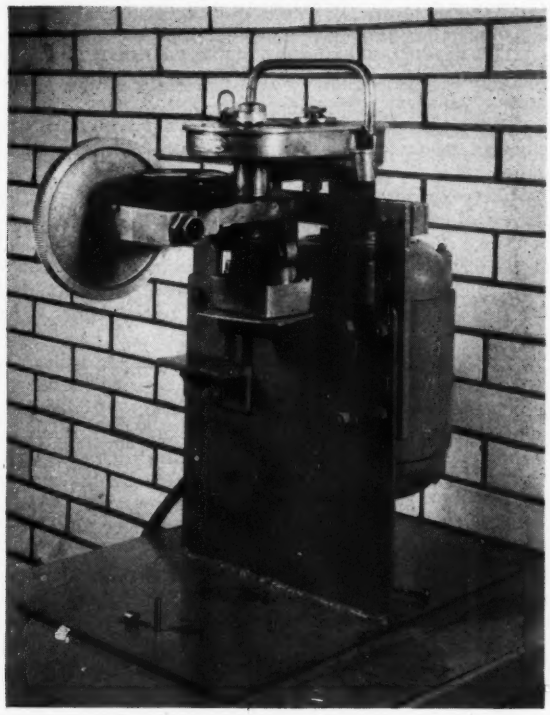


Fig. 15. Falex (Faville-Le Valley) Extreme Pressure Lubricant Tester

important physical characteristics with respect to effect upon performance. In a metal cutting operation, the optimum viscosity is largely dependent upon the nature of the operation and the actual cutting speed. In general, the viscosities of the cutting oils employed vary from approximately 40″ @ 100 F for high speed turning of aluminum and magnesium to 400″ @ 100 F, and sometimes higher for internal broaching operations where adhesive qualities are required. In high speed operations, low viscosities are desirable in order to effect greater cooling. On form and thread grinding, the viscosity is usually in the range of 200-350″ @ 100 F. Abnormally low viscosities in thread grinding oils increase the tendency toward atomization and decrease the amount of oil that adheres to the grinding wheel. In all types of operation, the foaming tendencies and amount of "drag-out" are normally less with the low viscosity oils.

It should be emphasized that at the temperature usually encountered at the cutting edge the viscosity of the cutting fluid, if it is a fluid at all under these conditions is very different than at 100 F. However, the viscosities mentioned above, based upon actual experience, have proved to be the most satisfactory.

While the color of the cutting oil has no direct bearing on its performance characteristics, in certain operations it is desirable that the oil be light colored, or at least transparent on the work. The lighter colored oils usually have greater operator appeal.

Of late years, the odor of cutting oils has become increasingly important, especially since the beginning of World War II, because of the large influx of women into the country's machine shops. Generally speaking, a product having an obnoxious odor will not even be tested in the average plant.

In general, the copper corrosion test, in which a strip of copper is immersed in the product for 3 hours at 212 F, determines whether th cutting oil is of the "corrosive" or "non-corrosive" type. If the copper strip is appreciably darkened or blackened, the product is classified as a corrosive cutting oil. Products of this type are usually intended for use in the machining of ferrous metals in machine tools which are not equipped with exposed moving parts consisting of brass or bronze. However, if the copper strip is only slightly darkened or discolored the product is classified as a non-corrosive cutting oil. The latter type is intended to be used in the machining of non-ferrous metals or in machine

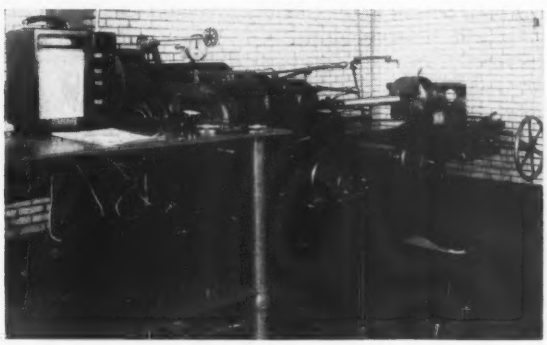


Fig. 16. Laboratory Test Lathe

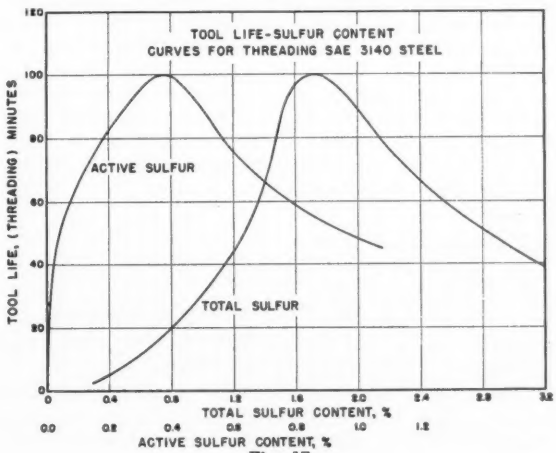


Fig. 17

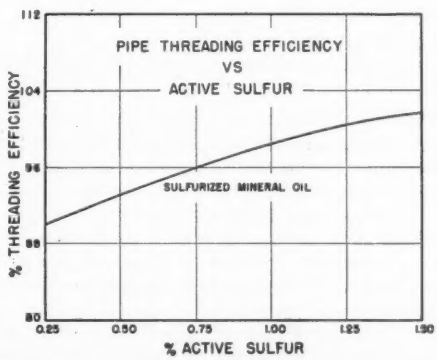


Fig. 18

tools, which can not tolerate the use of corrosive cutting oils, for example those automatics equipped with bronze gibs.

Years ago, it was common belief by both manufacturers and consumers of cutting oils, that the higher the total sulfur content of a product, the more effective it would be in a machining operation. Only quite recently has it been proved to the satisfaction of those most concerned that the active sulfur content is of far greater importance. What we are really concerned with, is the activity at the temperature of the cutting edge of the tool which may be in the range of 1000-1500 F. However, since it is impractical to determine the active sulfur content under these conditions with ordinary laboratory equipment, a temperature of 300 F has been chosen in the following method which has been quite widely accepted.

Briefly, a specified quantity of the product is agitated for a definite time with copper powder at 300 F. The oil is filtered and the sulfur content of the filtrate is determined. This represents the inactive sulfur. The difference between this and the total sulfur is the active sulfur content.

While the active sulfur content is obviously not an accurate measurement of the activity under metal cutting conditions, it serves as an indication.

The chlorine and phosphorus contents indicate the amounts of these elements present in the product. However, these elements are normally added in the form of compounds thereof. Accordingly, knowledge of the amounts of these elements present is of little advantage unless the nature of the compounds is known. Some of the latter are extremely difficult to identify, even by spectrographic and X-ray diffraction methods. These compounds may be added to impart extreme pressure and/or oiliness characteristics to the cutting oil.

Fatty materials are usually added to impart oiliness characteristics to the product. When sulfurized fatty materials are incorporated in the cutting oils, film strength and anti-weld characteristics are also improved.

The typical compositions of soluble fluids are as follows:

1. Conventional Type
   Emulsifiers plus Mineral Oil
2. Heavy Duty Type
   Emulsifiers plus Mineral Oil plus Additives

It will be noted that the conventional type soluble oils consist simply of emulsifiers and mineral oil.

The heavy duty soluble oils contain emulsifiers, mineral oils and other added materials. The latter may consist of oiliness additives and/or extreme pressure additives.

The physical tests usually conducted on soluble cutting fluids are the following:

1. Stability Upon Freezing
2. Stability of Emulsions in Tap and Hard Water
3. pH of Emulsions
4. Corrosion Tests

In general, it can be said that the physical and chemical tests have even less significance with respect to performance than those conducted on non-soluble oils.

The freezing test is quite important to insure that the product after storage at low temperatures, will be fluid upon returning to room temperature and indicate no separation. This is especially important during the winter months.

While the chemical tests will indicate the general composition of the product, it should be emphasized that an exact analysis is a difficult and time-consuming determination. Furthermore, it usually does not give the desired information regarding performance.

The product should form stable emulsions with tap water, and also in hard water where the latter condition prevails.

If the pH of the emulsion is excessively high, it may have an adverse effect upon the skin of the operators' hands.

Corrosion tests are important in order to predict the effect on machine tool parts and work pieces.

Since the determination of the physical and chemical characteristics of cutting fluids is not a reliable means of predicting metal cutting performance, attention has been given to several mechanical tests, namely the Almen and Falex Testers.

The Almen Tester, shown in Figure 14, utilizes a steel shaft rotating between two steel bearing halves, to which the load is applied. The load, in the form of two-pound weights, is applied to the pan, and is transmitted through levers and a hydraulic medium to the bearing halves. This tends to squeeze the latter tightly against the rotating journal. A small metal container is partially filled with the lubricant to be tested and placed so that the shaft and the bearing halves are immersed in the lubricant. A two-pound weight is applied every 10 seconds until seizure occurs, or until 15 weights have been added. However, the capacity of the machine is at least 30 weights. If, for example, seizure occurs after 12 weights have been applied, the OK load is reported at 11000 psi.

The Falex (Faville-Le Vally) lubricant tester, which is shown in Figure 15, is a device, in which a pin is rotated between two Vee-shaped bearing blocks. By means of a ratchet mechanism, the load can be increased between the blocks and the rotating pin. The oil to be tested is placed in the test cup so that the Vee-blocks and that part of the pin in contact therewith is submerged. After a brief run-in period, the load on the gauge is increased by 250 pound increments until seizure occurs. Provision is made to heat the oil to 210 F, if desired.

The results of film strength tests on typical cutting fluids using the Almen pin and Falex testers are shown below.

Film Strength Tests on Typical Cutting Fluids

	Almen Pin Test O. K. Load, psi	Falex Test, psi
Mineral Oil	3,000	250
Mineral Oil plus 20% Lard Oil	6,000	500
Sulfurized Mineral Oil	19,000	1,000
Heavy Duty Cutting Oil	20,000	2,000
Conventional Type Soluble Oil		
1–15 emulsion	4,000	4,500+
1–200 emulsion	.....	1,250
Heavy Duty Soluble Oil		
1–15 emulsion	30,000+	4,500+
1–200 emulsion	.....	2,625

It will be noted that there are certain discrepancies between the two tests. For example, the Almen test indicates that sulfurized mineral oil and a heavy duty cutting oil are approximately identical in performance. On the Falex test, the heavy duty product carries twice the load of the sulfurized mineral oil. Likewise, the performance of these products in actual metal cutting operations cannot be predicted from these results. Much depends upon the type of operation, metal employed and other operating factors.

Because of the lack of any other means of satisfactorily evaluating cutting fluids, laboratory test procedures have been established employing actual metal cutting operations.

Figure 16 shows a laboratory test lathe equipped with a die head, variable speed control, flow meter and temperature control for the sump. This machine tool has been used to satisfactorily evaluate cutting fluids by means of the threading operation. The latter was chosen because it is one of the most severe operations and indicates appreciable differences between cutting oils. By careful control of all of the variables involved, much reliable data have been obtained. Results of threading tests with typical cutting fluids are shown below.

Results of Threading Tests on Laboratory Test Lathe

	Mineral Lard	Low Active Sulfur	High Active Sulfur
SAE 3140 Steel (280 B.H.N.)			
Tool Life (Min. Threading Time)	2	90	39
Chaser Wear (Inches per Minute)	18.5×10^{-3}	4.3×10^{-3}	1.3×10^{-3}
Thread Finish	Passable	Good	Passable
SAE 1020 Steel (120 B.H.N.)			
Tool Life (Min. Threading Time)	11	20	55
Chaser Wear (Inches per Minute)	0.4×10^{-3}	0.4×10^{-3}	0.5×10^{-3}
Thread Finish	Barely Passable	Passable	Good

It will be noted that on the fairly hard SAE 3140 steel, a product which has a low active sulfur content outperforms the cutting oil having a high active sulfur content. On a soft, ductile steel, such as SAE 1020 H. R., the reverse is true. This is an excellent example of why knowledge of active sulfur content, or simply results of film strength tests, does not give reliable indications of performance. In this operation, the mineral-lard oil blend is inferior to the sulfurized product on both steels.

The curves shown in figure 17 indicate graphically, the effect of sulfur, both total and active, on tool life. With respect to total sulfur content, maximum tool life is effected when the percentage of sulfur is approximately 1.7%. When the active sulfur content is considered, maximum tool life is obtained at approximately 0.4%. Since active sulfur may be obtained from materials of varying performance characteristics, this is not the sole criterion for estimating tool life expectancy, even on a single type of metal.

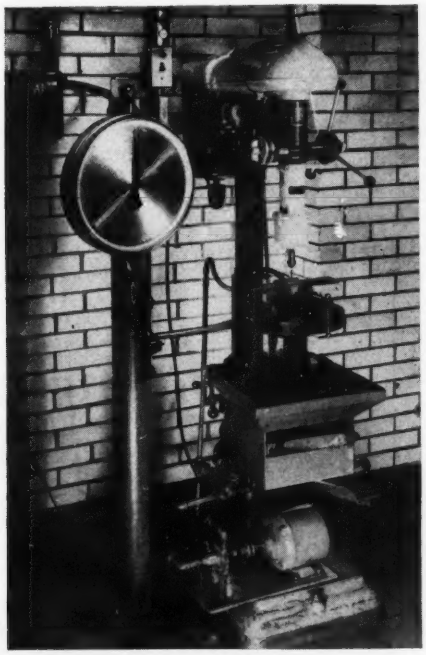


Fig. 19. Laboratory Tapping Machine

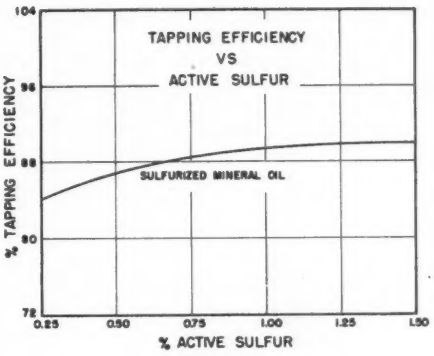


Fig. 20

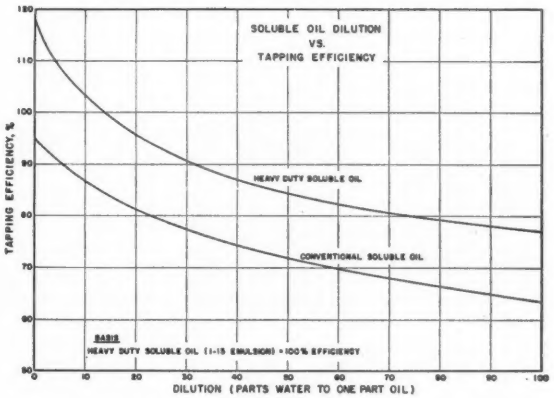


Fig. 21

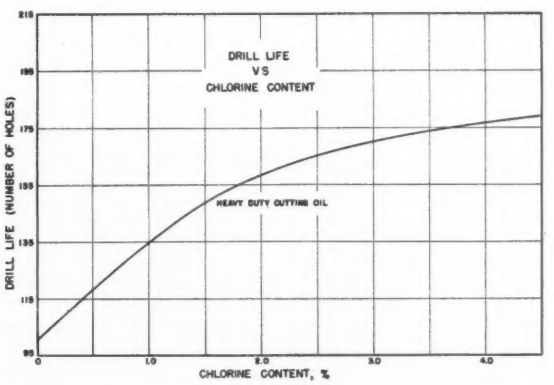


Fig. 22

The laboratory threading machine is equipped with a recording wattmeter in order to measure the power actually required in the metal cutting operation. In this test, since tool life determinations would be too extended, comparisons between oils are based upon power consumption. Since the latter varies with the degree of wear on the chasers, the actual power is meaningless unless it is compared with that determined on a standard product which is run directly before or after the material to be tested. By comparing the power requirements of the two cutting fluids, a relative efficiency can be calculated. This test procedure which is used mostly on

pipe, but is not limited thereto, has shown excellent correlation with field results.

The tabulation shown below indicates relative pipe threading efficiencies.

Pipe Threading Tests

Type Oil	Product	Emulsion Ratio	Threading Efficiency, %	Finish
Mineral Oil	Paraffin Oil	——	60	Rejectable
	Sulfurized Mineral Oil	——	89	Fair
	Heavy Duty Product	——	100	Good
Water Soluble	Heavy Duty Soluble Oil	1/15	57	Rejectable
	Conventional Soluble Oil	1/15	55	Rejectable

It will be noted that there is an appreciable difference between straight mineral oil and sulfurized mineral oil, both in finish and efficiency. The heavy duty product is used as the standard. Even the heavy duty soluble oils are ineffective on this operation.

The curve shown in Fig. 18 indicates the relationship of active sulfur to pipe threading efficiency. The efficiency varies directly as the active sulfur content.

The Laboratory Tapping Machine is shown in Fig. 19. In this equipment cutting fluids are evaluated by means of the tapping operation. It will be noted that the machine tool is equipped with a floating table and that the torque developed during the operation is measured directly on the scale. As in the case of the threading tests, measurement of tap life would be too prolonged. Accordingly, the tapping efficiency of a product is determined by comparing the torque developed with that of a standard cutting fluid. Obviously, the holes are drilled and reamed very carefully and a number of taps are used in order to insure that the results are reliable. This test has proved to be applicable to both non-soluble and soluble cutting fluids, and, in general, results have checked closely with field experience.

The relationship of tapping efficiency to active sulfur content may be shown by the curve in Fig. 20. As in the case of the threading tests, the tapping efficiency is improved by an increase in the active sulfur content of the cutting oil. However, in the tapping operation, this improvement is not as pronounced.

As illustrated in Fig. 21, the machining efficiency of a soluble cutting fluid generally decreases with dilution of the emulsion. It will be noted that this is true with soluble oils of both the conventional and heavy duty types. These curves show that under certain conditions the same results can be obtained by using either a dilute emulsion of a heavy duty soluble oil or a concentrated emulsion of a conventional type soluble oil. It should be emphasized, however, that with certain soluble oils, the degree of dilution is limited by the rust-preventing characteristics of the product.

Drilling tests are conducted with the use of the drill press. This machine tool is equipped with a triple spindle head in order that three drill life determinations might be conducted simultaneously. It is also equipped with a power feed, all tests being conducted under standard conditions. In order to accurately maintain cutting angles on the drills, a special drill grinder is employed. This controls both the point and the lip clearance angles.

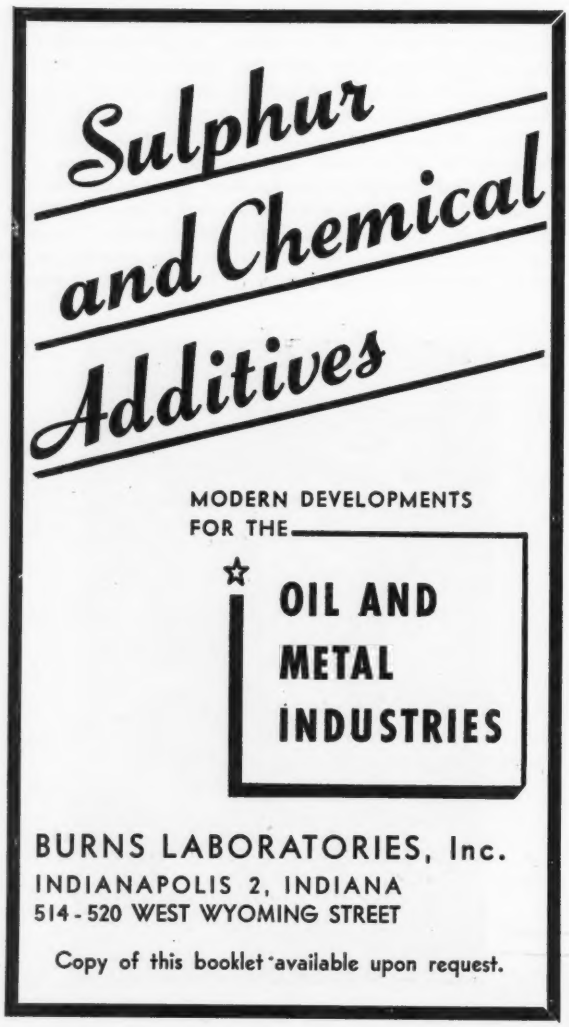
As an example of the type of data obtained with this equipment, attention is called to Fig. 22 which shows the relationship of drill life versus chlorine content, the sulfur content being constant. It will be noted that considerable improvement in performance is effected by the addition of chlorine.

While in the drilling tests, the presence of chlorine appears to be particularly effective, this is not generally true of all operations. Likewise, increasing the active sulfur content of a product may not necessarily improve performance, since much depends upon the type of metal and the actual machining operation.

In summarizing, while certain physicial, chemical and extreme pressure tests might give some indication regarding performance characteristics, to our best knowledge there is no substitute at this time, for evaluation of cutting fluids in actual metal cutting operations. Furthermore, since the performance is dependent upon the type of metal being machined and the nature of the metal cutting operation, these factors must also be considered.

It should be emphasized that in all of these tests, correct interpretation of the data is of primary importance. This is dependent upon correlation of an extensive background of information derived from formulation and laboratory evaluation with field experience.

It is possible that at some future date, more simple and accurate means might be available. In the interim, however, it would appear that accurate evaluations of cutting fluids can be conducted only in metal cutting equipment.



Lubrication of Industrial Gear Drives*

By F. RICHARDZ

Manager of Engineering, Gearing Division, Westinghouse Electric Corporation, Pittsburgh, Pennsylvania

GEARS are essential in modern industries. Without gears our industries could not exist. Lubrication is absolutely essential to gearing, therefore it can be said that without lubricants industry cannot exist.

The discovery of fluid film lubrication and the hydrodynamic action of the oil film is credited to Beauchamp Tower, an Englishman, who lived in the latter part of the eighteenth century. This discovery opened a new field of research for the petroleum industry to produce modern industrial lubricants.

Today, we in industry have an abundance of good lubricants, but we are faced with the problem of selecting the right lubricant for the application at hand in order to obtain the utmost in efficiency at the lowest possible maintenance cost. This does not mean that we accomplish this aim by the purchase of a low-priced lubricant. A lubrication engineer must look to his application and the particular apparatus and not the price of the lubricant.

In gearing, the maintenance of full film lubrication between gear teeth is a fundamental requirement for long life and satisfactory gear service. In general, it may be said that lubricants for enclosed gear drives to be satisfactory should be of high quality, well refined petroleum oil, non-corrosive, neutral in reaction, free from grit and abrasive matters, resistant to oxidation and sludging, possessing good demulsibility and having good defoaming characteristics. The viscosity of the lubricant should be selected to suit the ambient temperature conditions and the loads and speeds, for which the gear drive is designed. For example, heavilly loaded slow speed gears require a more viscous lubricant than do lightly loaded gears at relatively high speeds. Industrial gear drives of the enclosed type employing straight spur, single or double helical, straight or spiral bevel gears, may in general, be satisfactorily lubricated by straight mineral oil of suitable viscosity. This will, however, quite often be benefited by

the use of an oil having special additives such as a mild noncorrosive E. P. lubricant of the sulphurized or lead naphthanate type, particularly for the running-in period. By actual experience, the use of so-called mild E. P. lubricants for the "initial" running-in period of gearing, has

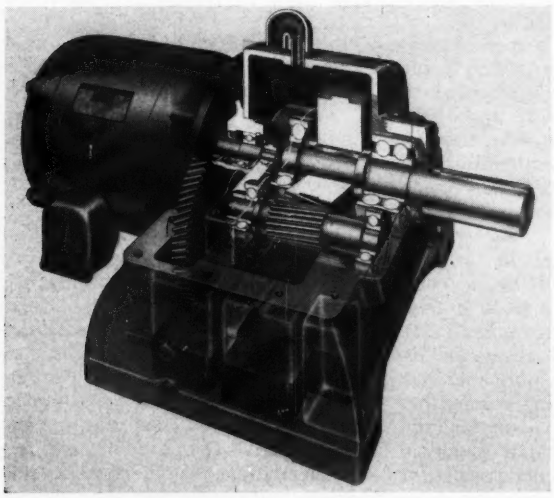


Fig. 1. Gear Motor of the Double-Reduction Type. The gears are lubricated by the splash method.

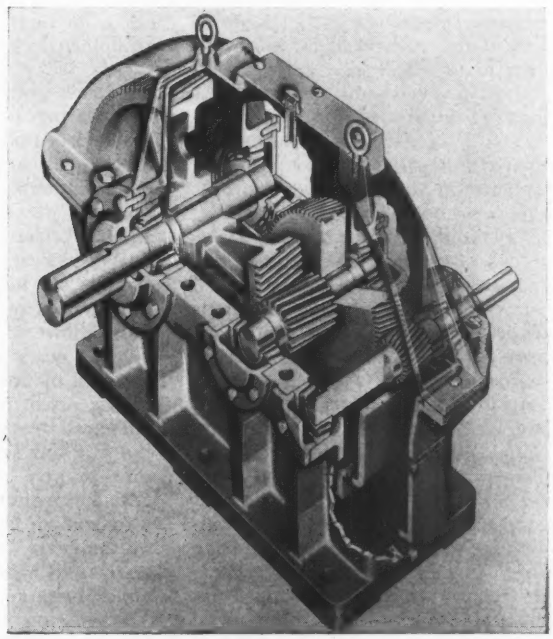


Fig. 2. Industrial Speed Reducer. The gears are dipping in the lubricant and the lubricant is carried by the gear teeth to the gear mesh.

* Presented at the annual meeting of the American Society of Lubrication Engineers, Pittsburgh, Pa., March 17-19, 1947.

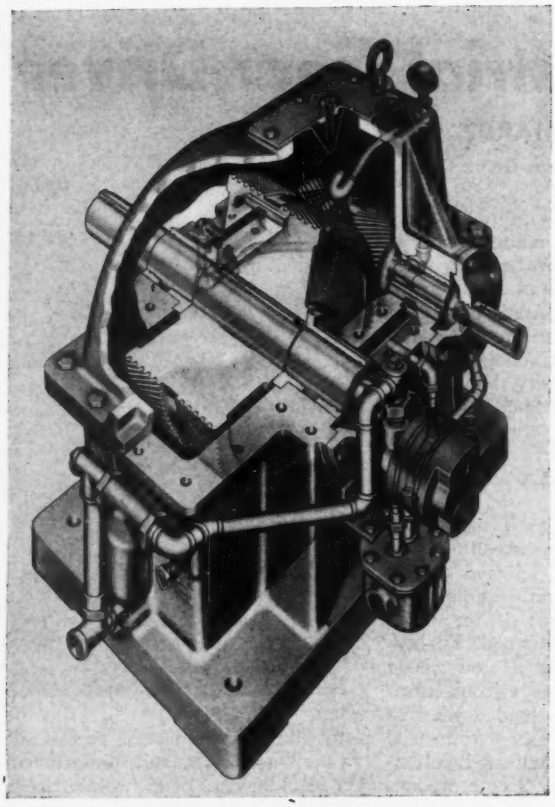


Fig. 3. Gear Unit Having Forced-Feed Lubrication. This type of unit has a self-contained lubrication and cooling system. The oil level is arranged so that the gears are not permitted to dip in the oil. This type of lubrication system is particularly adaptable where the pitch line velocity of the gearing is high or where the natural heat-transfer of the gear case is not sufficient for the application.

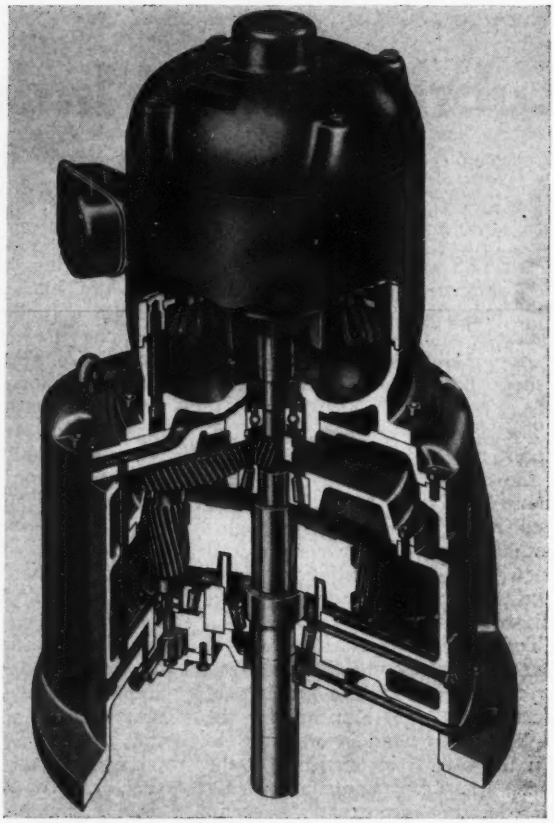


Fig. 4. Vertical Gear Motor and the Lubrication Scheme Used for This Type of Gear Drive.

been found to have definite advantages as they will to a great extent, prevent scoring and galling. This feature is attributed to these particular types of lubricants because of greater film strength and anti-weld properties. Mild E. P. lubricants have also been found to minimize, if not completely prevent, what is known as incipient or corrective pitting and even cases of aggravated corrective pitting, E. P. lubricants of the proper type and viscosity have been found to "arrest" the pitting. In course of time, the gearing tooth contact surfaces in such applications have polished up.

By the above referred to cases, it is not implied or intended to mean that an E. P. lubricant can be considered an effective means for increasing the load of the gearing where the metal is worked to compressive stresses or strength approaching the fatigue limits of the metal but that this type of lubricant has been found to be of value, especially during the running-in period of new equipment when it is inconvenient for the purchaser to gradually apply the loads until the loads for which the gearing is designed have been reached. Applications where heavy shock loads are encountered at frequent intervals are decidedly benefited by the continuous use of an E. P. lubricant.

Worn gear drives, in general, should be lubricated by a compounded oil of from 3 to 10% acidless tallow or similar animal fats. Hypoid gears should always be lubricated by an E. P. lubricant.

The art of producing gearing has advanced to such an extent within the last few years that it is seldom safe to give any general rule for gear lubrication. In the past, gears were seldom heat treated. The loads on the gears were, therefore, limited to relatively low compressive stresses and lubrication was not as critical. The gearing of today is generally heat treated and designed to carry heavier loads and consequently, higher compressive stresses. The lubrication of these gears, therefore, becomes more critical and demands a higher film strength lubricant.

Laboratory tests and investigations alone are not a definite criterion of a lubricant. Chemists, in general, do not have the necessary engineering experience and on the other hand, lubrication engineers generally do not develop their experience and judgment without the assistance of an experienced chemist. Thus, it is only by co-ordination between field engineering experience and careful laboratory investigations, that it is possible to collect the kind of knowledge that is essential to arrive at and give sound recommendations as to the most suitable grades and types of oils to be selected for a special application.

It is generally advisable to play safe and follow the gear manufacturer's lubricant recommendations, as he knows the type of gears employed and the stresses to which the gears are subjected. The general lubricant recommendations issued by the gear

manufacturers are based on normal operating conditions. Where other than normal operating conditions exist, such as high or low ambient temperatures, humid atmospheres, dust laden air, etc., special recommendations are often necessary in order to avoid excessive maintenance costs. These special conditions should be made known to the gear manufacturer in order that the proper lubricant and period between oil changes may be suggested. For example, a gear drive may be installed where the temperature may be exceptionally low during a certain period of the year, part of the time normal, and part of the time exceptionally high. Depending on the available facilities, several recommendations may be made such as:

1. Change of oil for each seasonal change in temperature.

2. For the low temperature, an immersion heater may be more suitable means and may avoid the necessity of changing the oil on a seasonal basis, as well as being instrumental in obtaining better efficiency and starting condition.

3. For the low temperature, a space heater may be installed to accomplish the same purpose as No. 2.

4. Where the temperature is exceptionally high, artificial cooling of the lubricant may be restored to, such as the installation of an air cooled or water cooled heat exchanger in combination with a circulating oil pump.

For normal operations, it is advisible to drain and filter the oil in the gear drive and refill to the specified oil level after one month (approximately 500 hours) initial service, after which changing the oil once every six months will ordinarily be sufficient. Where the air is dust laden or the operating temperatures are high, the oil will oxidize and sludge more rapidly and, therefore, more frequent oil changes will be required.

To obtain satisfactory and trouble free service life of enclosed gear drives, it is important that due consideration be given to the selection of the proper lubricating oil, the time interval between oil changes, the alignment of the gear drives to the driving and driven equipment and the foundation unon which the gear drives are supported.

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"The Evaluation of Motor Oils by the Underwood Oxidation Test"

By L. H. STRANAHAN

Metallurgist for the White Motor Co., Cleveland, Ohio.

THE quality of oil used to lubricate modern gasoline engines is as important as the materials which are used to build the engine. Without the high quality, non-oxidizing, non-corrosive oils which we have today, it would be almost impossible to deep the hundreds of thousands of motors in this country running efficiently day after day and week after week without frequent shut-downs for overhauling and cleaning.

The oil companies have kept up with the engine designs and have developed heavy duty oils which will lubricate engines for long periods without developing excessive corrosion or sludge forming properties. Some of these oils are excellent, some are good, and some are just fair.

The ability to evaluate these new type oils and in some way predict their life in an engine has made necessary an enormous amount of research and development work, with the result that numerous test procedures have been proposed, which are intended to measure some property of the oil.

The Indiana Oxidation Test measures the oxidizing properties of the oil. In this test, oxygen is bubbled through the oil, which is heated to a given temperature and may or may not contain a catalyzer in some form. Samples of the oil are withdrawn at intervals and tested to determine the amount of oxidation that has taken place. This test has been used on other than motor oils, such as transformer, hydraulic and turbine oils and gives valuable and reliable results, when oxidation characteristics and sludge forming properties are of first importance.

The Norma-Hoffman bomb oxidation test could be applied to oils as well as to greases for which it was primarily developed. It is similar to the bomb test which has been used on gasoline and similar products. In this test, the oxygen absorption is measured under specified conditions of temperature and pressure.

The MacCaull Corrosion Test (The Texas Oil Co.) was developed to measure the corrosive properties as they developed in the oil when it is heated and aerated. In this test, copper-lead bearings are revolved in a heated oil bath in such a manner as to produce a continuous flow of oil over the surface of the bearings and also, to aerate the oil. The bearings are removed and weighed at regular intervals and the weight loss taken as a measure of the corrosive properties of the oil. Samples of the oil are also withdrawn at intervals, the properties of which indicate the progressive changes produced by the test.

The Underwood Corrosion Test was developed by Arthur F. Underwood of General Motors Corp. and described by him in the SAE Journal of September, 1938. In this test, the heated oil is circulated by a pump and sprayed against the bearings. The bearings are weighed, and samples of the oil removed at regular intervals. Corrosion is measured by the weight-loss of the bearings. The properties of the oil samples indicate its stability or oxidizing properties. Although the results from this test do not always correlate with those obtained from full scale engine tests, the apparatus serves a useful purpose and produces valuable information in much less time than would be required for full scale tests. This is the test which we use for evaluating motor oils.

The machine as developed by Mr. Underwood consists of a spray chamber with a horizontal delivery tube, having four small openings or jets, equally spaced. Bearings or test pieces are mounted opposite the jets, so that oil issuing from the jets strikes the bearings. Under the spray chamber is a sump, where the oil collects and is heated by an electric heater controlled by a thermostat. A small gear pump picks up the oil from the sump and delivers it to the spray chamber.

The procedure as developed by Mr. Underwood was to heat the oil to 325 degrees Fahrenheit, circulate it at 10 psi pressure, and spray it against a copper baffle and a cadmium-silver bearing for 5 hours.

He states "Our experience indicates that a lubricant that does not corrode the cadmium-silver bearing in 5 hours in this test, will not cause corrosion in service, unless the driving conditions are unusually severe."

The requirements of heavy duty service may be termed "Unusually severe," and so we have extended Mr. Underwoods procedure to include two tests of 15 hours each. The first test is made with the oil as it is received; on the second test, a catalyst is added in the form of iron naphthnate. Three copper-lead bearings are used and the weight-losses are averaged. This produces a test, which is more severe than the one proposed by Mr. Underwood and in some cases goes beyond the point where the oil begins to deteriorate very rapidly. The recommendations of Mr. Underwood for cleaning the machine and bearings before each test are followed almost without exception.

Our Procedure for conducting this test is as follows:

Heat the oil to 325 degrees Fahrenheit and place bearings in position.
Run 5 hours.
Remove bearings, clean and weigh.
Withdraw sample of oil.
Replace bearings.
Run 10 hours.
Remove bearings, clean and weigh.
Withdraw sample of oil.
Drain and clean the machine, then repeat the test using fresh bearings and oil to which .01% iron has been added.

When an oil of good quality is subjected to this test, the results will be similar to those shown in Table 1.

TABLE 1

	Loss-grams Underwood	No. Neut.	Insol. % Naphtha	Sol. % Chloro.	Res. % Carbon	SUV 210F Viscosity	Increase %
New Oil	....	.10	.065	.048	.490	64.4	..
5 hours	.0062	.15	.090	.076	.594	65.5	..
15 hours	.0127	.40	.110	.090	.958	67.6	5.
	.01% Iron Naphthnate Added						
Oil	....	.10	.095	.055	.625	....	..
5 hours	.0215	.45	.228	.173	.855	67.5	..
15 hours	.0265	.95	.374	.230	1.491	71.6	11.
Corrosion Index	7.						

In the column headed Underwood Loss are four figures which represent the average weight-loss of the bearings, in grams, at different steps in the test. For purposes of evaluating the oil, we have found that four figures are inconvenient and cumbersome so we add them all together to produce one figure, then multiply by 100 to produce a whole number. This produces the figure 7, which we call the Corrosion Index. It could as well be called Corrosion Figure or Bearing Loss Indicator since it is an arbitrary figure which points to the bearing weight-loss during the test and fluctuates with it. This figure is important in evaluating the oil. The Neutralization Number usually confirms the indications of the Corrosion Index. The other properties, Naphtha Insoluble, Chloroform Soluble, Carbon Residue and Viscosity Increase indicate the progressive breakdown of the oil and measure the sludge forming properties. They are usually low when the Corrosion Index is low and high when the Index is high.

There is one interesting point in these figures. The Chloroform Soluble products are always less than the Naphtha Insoluables. This may indicate that the oxidation products of the oil contain relatively large amounts of hard gum varnish, which would tend to produce soft deposits.

This oil can be recommended for all heacy duty service. It will give long periods of satisfactory lubrication with a reasonable amount of attention.

TABLE 2

	Loss-grams Underwood	No. Neut.	Insol. % Naphtha	Sol. % Chloro.	Res. % Carbon	SUV 210F Viscosity	Increase %
New Oil	....	.10	.035	.035	.163	65.0	..
5 hours	.0066	.15	.325	.218	.400	65.9	..
15 hours	.0089	.70	.720	.557	.725	66.0	1.5
	.01% Iron Naphthnate Added						
Oil	....	.10	.035	.028	.185	....	..
5 hours	.0740	.30	.390	.258	.505	66.5	..
15 hours	.0927	1.00	.885	.690	1.000	68.0	4.6
Index	18.						

The oil shown in Table 2 has a much higher Corrosion Index than that in Table 1, but the other properties are very similar. Note the increased Underwood Loss after the addition of the iron catylist, while the Neutralization Number increases at a normal rate.

The Neutralization Number, alone, does not indicate the Corrosive Properties of the oil. In Table 1 the Underwood Loss and the Neutralization Number at the end of the test are .0265 and .95 respectively, while in Table 2 the corresponding values are .0927 and 1.00. The Neutralization Number is nearly the same but the Underwood Loss is almost four times as much in Table 2 as in Table 1. This may be due to the difference in the solvent action of the oxidation products, which do not react with potassium hydroxide; or it may be due to the action of the inhibitor in neutralizing the acids, formed in the oil. The Underwood Loss and Neutralization Number should be considered together.

While this oil is not quite as good as that shown in Table 1, it would provide satisfactory lubrication if changed at reasonable intervals.

An oil which will produce sludge and gum with resultant sticking valves and piston rings is shown in Table 3.

TABLE 3

	Loss-grams Underwood	No. Neut.	Insol. % Naphtha	Sol. % Chloro.	Res. % Carbon	SUV 210F Viscosity	Increase %
New Oil	....	.05	.049	.049	.243	56.7	..
5 hours	.0193	.10	.130	.102	.445	58.5	..
15 hours	.0123	.20	.515	.515	1.283	64.3	13.4
	.01% Iron Naphthnate Added						
Oil	....	.05	.090	.090	.588	....	..
5 hours	.0146	.10	.223	.223	.801	58.7	..
15 hours	.0171	.55	2.304	2.243	2.462	73.4	29.5
Index	7.						

While this oil is not corrosive as indicated by the Corrosion Index and the Neutralization Number, it will produce excessive amount of sludge and gum. This is indicated by the high figures at the end of the test for Naphtha Insoluble, Carbon Residue and Viscosity Increase. The high figures for Naphtha Insolubles indicate the absence of a detergent. The Chloroform Soluble is nearly the same as the Naphtha Insoluble, which may indicate that the oxidation products contain very little free carbon and would tend to produce hard sticky deposits.

This oil is not recommended for heavy duty service.

An an example of what may be expected from some oils, Table 4 shows results from an oil that becomes very corrosive and produces excessive amounts of sludge.

TABLE 4

	Loss-grams Underwood	No. Neut.	Insol. % Naphtha	Sol. % Chloro.	Res. % Carbon	SUV 210F Viscosity	Increase %
New Oil	....	.05	.058	.033	.447	61.6	..
5 hours	.0080	.20	.147	.112	.702	62.9	..
15 hours	.2488	.35	.336	.243	1.946	83.0	34.7
	.01% Iron Naphthnate Added						
Oil	....	.05	.097	.094	.559	....	..
5 hours	.1143	2.00	.570	.249	2.030	91.3	..
15 hours	.2875	4.65	12.27	12.10	2.690	326.4	430.
Index	66.						

The Corrosion Index of 66 means that this oil should not be used in contact with Copper-lead bearings. The high Naphtha Insoluble, Carbon Residue, and Viscosity Increase indicate the excessive sludge forming properties.

This oil should not be used in a heavy duty motor.

The Underwood Test will produce a wide range of values as shown in these tables. For the purpose of evaluating an oil, limits must be placed on these values and the limits must be determined by experience. It has been our experience, based on reports from our Service Department and from Fleet Owners, that these limits should be fixed as indicated in Table 5. Oils which show values higher than these figures will cause trouble.

TABLE 5

	Corrosion Index	Neut. No. %	Naphtha Insol. %	Carbon Residue %	Viscosity Increase at 210F %
1st 15 hrs.		1.0 Max.	1.0 Max.	1.0 Max.	10.0 Max.
2nd 15 hrs.	20 Max.	2.0 Max.	2.0 Max.	1.5 Max.	15.0 Max.

These properties may be separated into two groups. The first group, Corrosion Index and Neutralization Number are a measure of the Corrosive Properties, while the second group, Naphtha Insoluble, Carbon Residue and Viscosity Increase are a measure of the sludge forming properties and the degree of oxidation of the oil.

Some oils show a gradual increase in all the properties from the beginning to the end of the test. Others will show low results until near the end, when a sudden increase in all or most of the properties, indicates the

oil is breaking down very rapidly. These oils would give good results in service if they were changed frequently.

The accuracy of the results from the Underwood Test is an important factor in evaluating an oil. The machine must first be "broken-in" with two or three blank runs before a regular test is made. This produces a coating over the inside of the machine, which prevents the catalytic action of fresh metallic surfaces. With continued use, the coating accumulates in parts of the machine, which are inacessable and may poison the fresh oil and produce high results.

A reference oil, preferably a non-additive, paraffin base oil, may be used to check the operation of the machine. If test runs are made periodically, the results will indicate when the machine should be dismantled and cleaned.

That the machine will produce results in close agreement is shown in Table 6, which shows the Underwood Loss, after 15 hours, using the same oil run at different times.

TABLE 6

Date	*Underwood Loss*
December, 1943	.0107
September, 1944	.0113
December, 1944	.0095
August, 1945	.0135
December, 1946	.0108

Should this Underwood Loss rise to .02 or more the machine must be dismantled completely, cleaned in a hot alkali cleaning solution and reassembled. It is then treated like a new machine and several blank runs made to break it in before a regular test is made.

Reproducible results should be possible from one Laboratory to another, provided the same technique is followed. Variations may be due to slight changes in procedure which sometmies are not intentional. As a guide to closer agreement, our procedure is given in sufficient detail, so that anyone may follow it. This will produce a set of figures which, combined with service reports, or engine tests, will provide a means of evaluating motor oils.

APPENDIX

Operating the Underwood Machine

Several changes were made in the constructon of the machine as originally built which were designed to increase the ease of operation or prevent troubles.

The original machine was designed with an asbestos gasket on the cover of the spray chamber. This gasket became saturated with oil and disintegrated, allowing particles of asbestos to get into the oil and plug the openings in the spray tube. Leather was tried as a substitute material but the high temperature soon burned the leather and it became useless.

In order to eliminate the use of a gasket, a rim of thin sheet steel 1" wide was welded to the under side of the cover in such a position as to fit closely to the inside of the spray chamber. This prevents leakage and is much simpler to operate.

A petcock was introduced between the pressure gage and the oil line. The petcock is kept closed, except when adjusting the pressure at the beginning of the test. This prevents oil working into the expansion ring of the gage and giving a false reading.

A large socket wrench was made to fit over the heater unit, with which the unit may be easily removed for cleaning and replaced tight enough to prevent leaks.

A smaller pulley was placed on the motor, which reduces the speed of the pump from 1250 RPM to about 700 RPM and still will produce 10 psi pressure.

Cleaning Mixtures:

No. 1. Toluol . . . . . 1 part
Denatured Alcohol . . 1 part
Ethyl Acetate . . . . . 1 part

This is used for cleaning the bearings both before and after the test.

No. 2. Cleaner No. 1 . . . . . 1 part
Light Oil . . . . . 1 part

This is used for cleaning the machine just before flushing with the oil, which is to be tested. The oil for this mixture may be the flushing oil from previous test. It is convenient to mix about 1 gal. at a time.

No. 3. Chloroform.

This is used to wash the screen of the machine with the aid of a small paint brush. The chloroform is retained from the "Chloroform Soluble" determination and may be used several times for cleaning the screen, which may occur after only a few tests is the oil is of a sludging type.

No. 4. Kerosene.

This is used for rinsing the oil out of the machine after the test. Any petroleum solvent would serve the purpose.

PROCEDURE

The machine having been cleaned from the previous test:

Step #1. Flush with 1 quart of Cleaning Mixture No. 2. Circulate about 5 minutes and drain.

Note: When draining the machine, open the petcock and allow the oil to run out until the heating chamber is empty, then turn on the motor for a moment to force the oil out of the pump and lines. Drainage is complete when the stream from the petcock changes to drops.

Step #2. Flush with 1 quart of the oil to be tested. Turn the heater to "high" and circulate the oil until the temperature reaches 275 F or above. Drain. Refer to note, Step #1.

Step #3. Charge with 2 quarts of the oil to be tested, turn the heater to "high" and circulate until the oil reaches a temperature of 325 F.

Note: When the oil is to be tested with a catalyzer, this is added to the charge at this step. Weigh 2.80 grams of Iron Naphthnate, which contains 6.0% iron into a small beaker. If the Iron Naphnate contains more or less than 6.0% iron, vary the amount taken to produce 0.01% iron in two quarts of oil. Add oil to the beaker and heat to about 150 F, stir and add it to the oil in a partly filled quart measure. Fill the quart measure and transfer it to the machine. Add another quart of fresh oil to the machine, circulate and heat to 325 F. After the oil is thoroughly mixed, a 50 cc sample should be withdrawn for the determination of Carbon Residue, Neutralization Number, and Naphtha Insoluble.

Step #4. When the oil reaches a temperature of 325 F, shut off the motor; place the weighed bearings in position; turn on the motor and adjust the pressure to 10 pounds, and set the timer to shut off after 5 hours.

Note: A timer which shuts off the motor and heater at the end of a run is almost a necessity.

Step #5. At the end of 5 hours, remove the bearings, wash lightly with gasoline, remove them from the mountings and wipe off the excess oil with a paper towel or cloth. Wash in two successive baths of Cleaning Mixture No. 1, wiping dry with a clean cloth after each washing, cool and weigh. Withdraw a sample of about 300 cc for further tests.

Note: Some oils produce a black coating on the bearings which is very adherent and very difficult to remove. In some cases the bearings will weigh more than they did before beginning the test. Light rubbing with the back of a smooth spatula cracks the film and it may then be rubbed off with a towel dipped in Cleaning Mixture No. 1.

While the bearings are being weighed, turn on the heater and circulate the oil, so that it is ready for the bearings as soon as weighing is finished.

Step #6. Replace the bearings in the machine in the same position as at the beginning of the test, turn on the motor and set the timer at 10 hours.

Step #7. After the 10-hour run, remove the bearings, clean as in step 5 and weigh. Turn on the heater and circulate the oil until the temperature has reached 150 degrees Fahrenheit to 200 degrees Fahrenheit. Withdraw a sample of about 300 cc for further tests. Drain the remaining oil and discard.

Step #8. Flush with Kerosene 3 times, using 1 quart each time. Circulate the Kerosene 5 to 10 minutes after heating to 100 to 125 degrees Fahrenheit. The third washing may be retained and used for the first washing after the next run.

Step #9. After the final wash with Kerosene, all accessable parts are wiped dry with paper or cloth towels.

Remove the jet tube and force a small rag through it to dislodge any particles of carbon or dirt.

Disconnect the spray chamber and wipe it dry both inside and out. Remove the screen and wash it in Chloroform using a small paint brush to dislodge the accumulated deposit of oxidized oil. Wipe the inside of the sump dry. Remove the heating coil. Scrape the excess of carbon from the heater legs and finish by wiping with a cloth. It is not necessary to sandpaper all the carbon from the heater legs as this would produce fresh metal surfaces and may change the results. Wipe the inside of the heating chamber as dry as possible. Assemble all parts in their respective positions and the machine is ready for the next test. See Step No. 1.

Preparation of Bearings

The jet tube of the Underwood Machine has 4 jets and 4 positions for mounting test bearings. Assume these positions to be numbered from 1 to 4, beginning at the left. Our procedure has been to place a new unsanded, Indium treated bearing in position No. 1 for each test. This is for the purpose of determining the action of the oil on an Indium treated surface. Any weight loss is not included in the average loss of the copper-lead bearings.

The copper-lead bearings are shifted one position to the right after each tech. That is, the bearing in No. 4 position is removed; No. 3 is shifted to No. 4; No. 2 is shifted to No. 3; and a new bearing is placed in position No. 2.

A file mark serves to number the bearings so that they may readily be identified and replaced in their original position. At the end of the run the numbers are easily changed by adding another notch.

The three copper-lead bearings, properly marked, are scraped with a three-cornered bearing scraper to produce a fresh surface. The amount of material removed will vary from about ½ gram, if the loss in the previous run has been low, to 1½ grams, if the loss has been high. The fresh surface is indicated by the silvery white color of the metal as contrasted with the coppery red of a surface, from which the lead has been removed.

The bearings are then sanded with No. 80 emery to remove the scraper marks; washed once in cleaning mixture No. 1, dried, and weighed.

The copper baffle, whcih is 2" wide by 10" long, bent to conform to the outside of the bearings, is sanded with No. 80 emery on the inside surface only.

The bearings are then mounted with the copper baffle on the carrier bar and are ready to be placed in the machine.

BIBLIOGRAPHY

1. C. M. Loane and J. W. Gaynor. "Bearing Corrosion Characteristics of Ooils: Indiana Stirring Corrosion Test". Industrial and Engineering Chemistry. Analytical Edition. 17:89-95. February, 1945.
2. G. W. Waters, E. C. Larson and B. Borus. "Corrosion and Stability Test for Lubricating Oils". National Petroleum News. 36 pt. 2, R-176 March 1, R-224 April 5, 1944.
3. C. L. Pope and D. A. Hall. "Oxidation Corrosion of Lubricating Oils". National Petroleum News. 35 pt. 2, R-279-81. June 2, 1943.
4. N. MacCoull, E. A. Ryder and A. C. Scholp. "Oil Corrosion Tester: a Simplified Apparatus for Testing Corrodibility of Bearings and Corrosiveness of Lubricants". S.A.E. Journal 50, 338-45. August 1942.
5. C. M. Loane and J. W. Gaynor. "Indiana Stirring Oxidation Test for Lubricating Oils". Industrial and Engineering Chemistry. Analytical Edition. 13, 317-21. May 15, 1941.
6. S. K. Talley, R. G. Larsen and W. A. Webb. "Laboratory Machine for Investigating Corrosion of Bearings." National Petroleum News. 33, R-294. September 17, 1941.
7. H. C. Mougey. "Underwood Oxidation Test on Oils and Its Correlation with Service". Automotive Industries. 80, 658-60. June 1, 1939.

DEALER'S "RATE"

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LUBE SPOTS

We have in previous issues discussed several phases of industrial lubrication, and in this article we are going to dwell on "Preventive Maintenance."

In all plants large enough to have their own machine shop, where burned out and defective bearings are renewed and repaired, it has generally been very easy for the repair man to diagnose all failures as "lubrication trouble." In a large percentage of these cases the diagnosis has been correct, but in a large number of instances where sleeve bearings have failed, the difficulty has been in improper alignment of the shaft, thus causing excessive friction which no lubricant could overcome. Such an incident generally results in an argument between the lubrication group and the machine shop. A good practice for the Superintendent or Foreman of lubrication is to follow up each instance of bearing failure and see that the case is properly diagnosed and the faulty conditions remedied. Conditions throughout industry are slowly changing and the importance of systematic and proper lubrication is being more forcibly brought to the attention of those in charge of mechanical repair. While it is a fact that no lubricant can take the place of bearings, yet proper adjustment plus proper lubricant is the combination which will increase bearing life remarkably.

There are a great many factory conditions which will bear looking into. A short time ago, in a certain plant, there were twenty-six internal grinders which had been running consistently and with very little trouble. All at once spindles, one after the other on this group began to fail. The trouble was found to be not faulty lubrication but improper care of the machine. The oil, which was fed to the spindle through a sight feed cup at the top of the arm, was conducted down to the spindle through a two foot copper tube. After more than a year of operation, these tubes gradually filled up with emery dust and bond from the wheels. Gradually the aperture, through which the oil was delivered, became smaller and finally closed entirely, not admitting any oil to the spindle bearings which naturally failed. This failure arose from the inattention of the oiler in charge, as he should have noticed the decreased use of oil on this line. After the spindles were repaired, tubes blown out with compressed air, there was no further difficulty. From that time on these tubes were cleaned out at six months intervals with no interruption in production.

This may seem a small point to consider but it is the difference between continuous production or a shut-down for a change of spindles.

There are many parallel cases in the average plant, where care outside of the regular oiling can be used to good advantage. It has often been found that a certain machine will be located adjacent to a type of grinder that throws a great deal of dust. This particular machine may have a hydraulic reservoir. Care should be taken that all openings to this reservoir are sealed tightly to prevent an accumulation in the reservoir of this contaminant. Inasmuch as hydraulic fluid is in continuous circulation, it is very easy to pick up foreign material circulated through the system, clogging valves and in general producing poor operating conditions. It is then very easy for the operator of the machine to place the blame on the hydraulic fluid where a little care exercised in making contamination impossible would have been in the line of "Preventive Maintenance".

While on the subject of hydraulic fluids, we might mention that many machines are so designed that the cutting fluids flow into and mix with the hydraulic oil, causing not only a discoloration but bringing in all sorts of contaminants. The source of these leaks can be easily found and remedied by the machine shop. Cold weather plays an important part in lubrication in the average plant where lubricants are stored in outside oil houses without heat. Naturally the viscosity of any oil is increased to a great extent by cold and sometimes the barrel spindle oil will be brought in from a cold warehouse, immediately drawn off and applied. If at that instant the oil in the spindle has run out, the viscosity of the oil just introduced will be too high to have any immediate effect on the spindle bearings, and while the heat generated in the bearing will be sufficient to bring down the viscosity, it may not do so fast enough and the bearing may fail. Oil should be stored in rooms of approximately the same temperature in which it is used and the choice of viscosity should be figured accordingly.

It has often been noted that two machines designed exactly alike give a different performance as far as lubrication is concerned. Oftentimes this is due to a difference in temperatures.

All oil cups and application devices should be inspected periodically and cleaned throughly, so that the proper amount of oil flows according to the original setting. Often-times the operator of a machine may carelessly change the set on an oil cup, increasing or decreasing the flow and in some cases shutting it off entirely.

Gear reservoirs have sometimes been so carefully hidden by machine manufacturers that they have been overlooked. There is one instance that came to the writer's attention some time ago: A large upright drill was equipped with an intricate system of horizontal gears. No lubrication appliance was provided and no outlet or intake for oil was apparent. This machine had been in constant use for approximately six months when there was a sudden gear failure. When taken down it was found that the oil intake to this particular gear reservoir had been so carefully hidden that it had been completly overlooked by both the lubrication and tool room men. A new intake was made, proper facilities for conducting the oil to the gears and draining the used oil were added, and no further trouble was experienced.

It is encouraging to note that many of the machine manufacturers are today calling on lubrication engineers to consult with their designers before releasing a new design. In this way, much trouble is avoided and production sustained.

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NEW BOOKS

A.S.L.E. Announces:

The publication of a new book, entitled, "*Friction and Wear of Piston Rings and Cylinders,*" by the famous German scientist, Reemt Poppinga. The following is a synopsis of the thoughts presented in the Introduction. Industry must be conscious of wear especially with the increased use of high-speed machinery. It is important to be constantly aware of preventitive measures, the lack of which may produce serious financial loss. In the interest of an efficient economy preventitive measurements must be taken.

In order to do this it is important to have basic knowledge concerning the causes of wear. Up to now very little has been done in this field. Many factors influence the wear process—not only in terms of the complex structure of the materials that are used but also in terms of the lubricants that are available. It is impossible to point to any one factor as the cause of wear.

In the last analysis, every investigation of wear has as its immediate purpose the preservation of valuable machine parts and as its ultimate purpose the maintenance of a sound economy.

The Society of German Engineers (V.D.I.) at their meeting in October, 1938, decided to investigate this problem thoroughly. The research reported in this volume was conducted for the Institute of Transport at the Technical University of Dresden.

The Reich Ministry of Transport once sponsored a program similar to this that was concerned primarily with cylinder and piston-ring wear. Valuable as these results were, they did not prove conclusive. The problem seemed to call for a more exhaustive investigation.

Therefore this specific research program was designed to investigate the problem of wear in all of its remifications and in particular with relation to cylinder and piston-ring wear.

A total of 636 references are cited.

There are 74 diagrams, photographs and curves.

The book will make its first public appearance at our Convention in Buffalo, in April, 1948.

PHOTOELECTRIC CELLS—

By A. Sommer.
Chemical Publishing Company, Inc. Brooklyn, New York—1947. 104 pages. Price, $2.75.

This book covers photoelectric cells of the emission type. After a brief historical introduction it develops the theory of photoelectric emission. Consideration is given to the manufacture and properties of typical photoelectric cathodes and detailed discussions then follow on vacuum photocells, gas-filled photocells and multiplier photocells, with finally a discussion of applications.

The text stresses points to be considered in selecting suitable types of cells and indicates a surprising number of applications which can be made of these devices. In its small size, it covers a wealth of material.

—B.H.J.

RARER METALS—

By J. De Ment and H. C. Dake.
Chemical Publishing Company, Inc. Brooklyn, New York—1946. 392 pages. Price, $7.50.

This book covers the need for a concise publication to present the mineralogy, chemistry, physics, and technology of the less common metals. The authors have done an outstanding job in assembling data and factual information from a wide variety of sources.

Among the metals covered are: Beryllium, Gallium, Indium, Thallium, Germanium, Titanium, Zirconium, Hafnium, Thorium, Vanadium, Columbium, Tantalum, Molybdenum, Tungsten, Uranium, Selenium, Tellurium, Platinum, Palladium, Rhodium, Iridium, Osmium, Ruthenium. Some of these metals are so new commercially that many of us are hardly familiar with their names.

The book does not endeavor to supply comprehensive analytical methods of testing, but it does present some of the newer testing methods used in microchemistry and fluorochemistry.

A relatively comprehensive bibliography of the literature of rarer elements appears at the end of the book.

—B.H.J.

Silicone News

DC SILICONES

Instead of straws in the wind we observe precise instruments like the "Windial" made by the Friez Instrument Division of Bendix Aviation Corporation.

The "Windial"* points to permanent lubrication

Generations ago men could afford to measure the wind by watching straws blowing across the barnyard. They could afford to lubricate their wagon wheels with soap. We can't afford that kind of extravagance. Too much depends upon which way and how fast the wind is blowing. Too much depends upon keeping our precision instruments, our machine tools and the motors which drive them turning on anti-friction bearings.

Instead of soap or even the most carefully compounded petroleum greases we use Dow Corning Silicone Greases to get lasting lubrication under adverse conditions.

Take the "Windial" for example. It is set up high where the wind blows free. It stays outdoors year after year in the sun and rain, in the snow and ice. Temperatures may vary from −40° to 120°F. Speed varies from 0 to about 2000 r.p.m. The best of the organic greases wouldn't last long under such conditions.

That's why Bendix-Friez engineers tested and adopted DC 33 Silicone Grease for lubricating the annular ball bearings which take both radial and thrust loads from the propeller shaft of the "Windial."

That's another bit of evidence to support our claim that permanent lubrication means Dow Corning Silicone Oils and Greases. Within 5 years your customers will be demanding permanent lubrication. It's none too early to start working with the DC Silicone Greases described in data sheet No. P7-1.

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NEWS OF INDUSTRY AND PERSONNEL

The Pallet Engineering Company announces the new Tray-Hart multiple drum carrier as an accessory to the regular industrial fork truck which is said to greatly increase the efficiency of drum handling.

The standard model will handle steel drums of 55-gallon capacity or special requirements will be filled. It is said that no special tools are necessary to attach the Tray-Hart carrier after the initial installation has been made, and the simplicity of design allows a minimum of service and maintenance, the design for installation on any standard industrial gasoline or electric power fork truck.

For additional information, write this publication or Pallet Engineering Company, 725 Second Street, San Francisco 7, California.

Universing Grinding Coolant

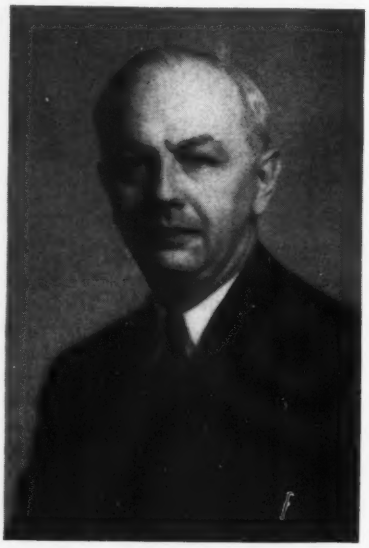
MACHINERY LUBRICANTS, INC., 31 St. James Ave., Boston 16, Mass., has available an interesting 4-page circular describing "SILVER-CHIP" No. 2—an ultra modern precision grinding compound FOR ALL METALS—recently developed and being marketed nationally by this company. Copy of circular will be furnished upon request to personnel of metal-working plants.

FALSE REPORT

In line with what Mark Twain once said, Mr. George L. Rector is now claiming that the reports of his death were greatly exaggerated, and he writes us a letter stating that he is not only very much alive but practically challenges us to best him in several different games.

We hope to have the opportunity to test our skill with Mr. Rector and we wish to make public apology for listing him in our membership roster as deceased.

Such exaggerations are bound to occur occasionally. We don't know how it happened, but it did.



Deutsch Named Trabon Sales Head

Wilbur Deutsch has been appointed General Sales Manager of Trabon Engineering Corporation, Cleveland, Ohio.

Since joining the Trabon organization in 1936, he has served the Company four years as Sales Engineer and Erection Superintendent and for five years was associated with F. R. Magill in Pittsburgh, Pennsylvania. During the past two years he has been in charge of Sales and service for Trabon on the West Coast.

Schmitz Becomes Vice President

It was very gratifying to the many friends of Carl E. Schmitz to hear that he had been named Vice President and Director of Engineering of his company. Mr. Schmitz has been with the Crane Packing Company for several years and, before his promotion, was Chief Engineer.

Mr. Schmitz has been active in A. S. L. E. work in the Chicago area and, at the present time, is Chairman of the Program Committee of the Chicago Section.

Our best wishes go to Carl in his new position.

New Bowser, Inc., District Manager

Bruce W. Grosvenor was appointed District Manager of the Bowser, Inc. Sales and Service Office, 966 Broadway, Albany, New York, effective January 1, 1948, according to an announcement by Fred S. Ehrman, General Sales Manager of Bowser, Inc., Fort Wayne, Indiana.

Prior to his present appointment he was Sales Manager of the General Line Division.

Mr. I. D. Bone, former Albany District Manager, resigned due to ill health after twenty-seven years with the Bowser organization, twenty of which were in Albany.

Machinery Lubricants, Inc. Names Thomas Nelson

Machinery Lubricants, Inc., Boston, Mass., has appointed Mr. Thomas Nelson as Director of Research and Engineering.

Mr. Nelson is a graduate of Massachusetts Institute of Technology, has served several years in the research department of one of New England's large manufacturing concerns and another thirteen years as factory manager of a business constantly developing problems of chemical engineering.

All matters pertaining to the research and manufacturing of Machinery Lubricants, Inc., products will be centralized into the able hands of Mr. Nelson.

PALUMBO DEVELOPS REVOLUTIONARY CAM PRINCIPLE

A revolutionary principle concerning internal combustion engines has been patented by Vicent Palumbo, inventor, Engineer, and president of the Pal-Vin Machine and Manufacturing Co., Cleveland, Ohio. The ultimate result of the invention via the cam principle is that the piston used in an engine has a true harmonic motion, while the shaft has a uniform rotory motion.

This principle supersedes the basic crankshaft principle of power development, and in so doing creates great improvements in the operation of the engine. The efficiency of the engine is actually increased *one third* by less frictional loss, and more power is achieved because each stroke is more uniform, with an equal expenditure of power on the full stroke which is completely harmonious. Also, because of the efficiency of design, the overall size of any engine is reduced considerably by the cam principle of power drive.

Of equal importance to the patented principle is the fact that a tool layout has been prefected for the mass production of the cam members.

The basic factors involved in the invention are:

1. In crankless mechanism for converting reciprocating motion into rotary motion and vice versa with an effect simulating that of a crank transmission, two relatively movable instrumentalities, the first consisting of a rotatable supported drum cam having an endless helical peripheral groove characterized by reversely inclined reaches and of such shape that a point traversing the center line of the groove and progressing with uniform motion circumferentially of the cam will vibrate axially thereof with true harmonic motion, the second instrumentality consisting of a thrust element engaged within said groove, means restricting movement of the second instrumentality relative to the first to a direction axially of the latter, and means for delivering motive power to one of said instrumentalities.

2. In crankless mechanism for converting reciprocating motion into rotary motion and vice versa with an effect simulating that of a crank transmission, two relatively movable instrumentalities, one consisting of a rotatably supported drum cam having an endless helical peripheral groove characterized by reversely inclined reaches and of such shape that a point traversing the center line of the groove and progressing with uniform motion circumferentially of the cam will vibrate axially thereof with true harmonic motion, the distance at the cylindrical surface of the cam, between planes normal to the axis of the cam and coinciding with the center of the groove at the extremes of said reaches, approximating the radius of the cam, the second instrumentality consisting of a thrust element engaged within said groove and restricted in its movement relative to the first instrumentality to a direction axially of the latter, and means for delivering motive power to one of said instrumentalities.

3. Crankless mechanism, according to claim 2, wherein said groove is composed of four equal, reversely inclined reaches.

4. In crankless mechanism for converting reciprocating motion into rotary motion and vice versa with an effect simulating that of a crank transmission, two relatively movable instrumentalities, one consisting of a rotatably supported drum cam having an endless helical peripheral groove characterized by reversely inclined reaches and of such shape that a point traversing the center line of the groove and progressing with uniform motion circumferentially of the cam will vibrate axially thereof with true harmonic motion, the angle between adjacent reaches being approximately 90°, and the sides of diemetrically opposite portions of the groove in any transverse plane of the groove converging along straight lines that intersect at the axis of the cam, the second instrumentality consisting of a thrust element engaged within said groove and restricted in its movement relative to the first instrumentality to a direction axially of the latter, and means for delivering motive power to one of said instrumentalities.

5. Crankless mechanism, according to claim 4, wherein the inner sides of contiguous reaches at each turn of the groove join in such manner as to define a sharp point adjacent the bottom of the groove.

6. In crankless mechanism, a shaft, a drum cam on the shaft rotatable therewith and having an endless helical peripheral groove of the shape of a true harmonic curve, and a thrust element engaged within said groove and confined in its movement relative to the cam to a direction axially of the latter.

For further information, write the Pal-Vin Machine and Manufacturing Co., 1419 East 40th Street, Cleveland, Ohio.

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NEWS OF THE SECTIONS

New Baltimore Section Organized

At a meeting held in the Lord Baltimore Hotel, Tuesday evening, January 27th, a group interested in industrial lubrication gathered to organize a local section.

Mr. Wilbur Deutsch, of Cleveland, introduced national president, Oscar L. Maag, who gave a brief talk on the aims, purposes and accomplishments of the Society.

Mr. Paul Chappell, of the American Oil Company, was elected temporary chairman, and a nomination committee was selected to choose candidates for the various offices.

The Officers and Directors of the society extend a hearty greeting to our new Baltimore section, and know it will be a valuable addition to our list of Sections.

NEW YORK

The regular monthly session of the Section was held on November 20th, with 100 members and guests at the meeting which followed the dinner at the Midston House.

Speakers of the evening were Virgil L. King, Chief Engineer of Hills Brothers, who talked interestingly on the subject of "Plant Maintenance in a Coffee Producing Plant." Mr. King accompanied his talk with colored sound motion pictures and discussed the many problems connected with the lubrication of coffee producing machinery.

Mr. Charles H. Parks, Assistant Works Manager of the Bullard Company covered the subject of "Plant Maintenance From the Viewpoint of the Tool Builder," in which he outlined the importance of lubricants for the precision tools manufactured by his company.

The next meeting is scheduled for January 22nd when Mr. J. C. Van Gundy will talk on "Industrial Hydraulic Oils."

DETROIT

The first annual Christmas party was held on December 17th in the Spanish Room of the Fort Shelby Hotel, with 127 members and guests attending. Entertainment was provided and during the evening the officers for the coming year, who had been elected at a previous meeting, were introduced.

It is planned to make this Christmas party a regular annual feature of the Detroit section.

The Secretary announces that the regular monthly meetings for 1948 will be the fourth Monday of each month at the Rackham Building, Detroit.

BUFFALO

The monthly meeting of this Section was held January 21st at the Westbrooke Hotel in Buffalo.

The meeting was attended by 81 members and guests and included the Officers and Directors of the National Association, who had earlier in the day held their regular quarterly Directors' meeting in Buffalo at the Statler Hotel, where details of the forthcoming Convention and Exhibits were discussed and for which arrangements were perfected.

The subject of the meeting was "Ball Bearings—Their Installation, Care, and Lubrication."

The program was in charge of Mr. Varian Steele of Industrial Bearings Company in Buffalo.

The Section Officers have asked this publication to announce the fact that they expect a large turn-out at Buffalo for the Convention and that a very elaborate program of entertainment for members and guests is in preparation

ST. LOUIS

Fifty members and guests attended the January 20th meeting of this Section.

Subject, "Some Phases of Bearing Research in Mechanical and Electrical Industries," by Mr. John Boyd of the Research Laboratories, Westinghouse Electric Mfg. Corp., Pittsburgh was of great interest to the audience.

The talk was illustrated with Koda-Chrome slides and 16mm film.

The next meeting will be on February 17th, at which the speaker will be Mr. Frank Ross who is well known among our Sections.

NORTHERN CALIFORNIA

The regular monthly meeting was held on January 8th, preceded by dinner.

Mr. Harvey G. Isbell was Acting Chairman of the meeting.

Mr. J. M. Stokeley from the California Research Corp. presented an interesting paper on "A New Performance Test on Cutting Fluids." This was followed by a sound film on the manufacture of bearings presented by Mr. Kerruish of the Cleveland Graphite Bronze Company.

The Chairman then announced that National President Oscar L. Maag would attend and address their March meeting.

CHICAGO

A very successful Christmas party was held by this Section on December 16th. A variety of entertainment and community singing was enjoyed by members and guests.

The next technical session is to be held on January 29th and in February, a joint meeting with the Tool Engineering Society is planned, at which Mr. William Oldacre will talk for the A.S.L.E. on "Required Cutting Fluids for Different Tool Designs" which will be accompanied by pertinent observations on tool design and cutting fluids by various members of the Tool Engineering Society.

An interesting evening is anticipated.

(*Continued on page* 38)

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(*Continued on page* 38)

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Membership in the Society is in several grades as defined below. Assignment to grade is made by the Admissions Committee or Board of Directors on the basis of information submitted or supplied by references.

MEMBERS
$10.00

Members shall be: (1) persons not less than twenty-four years in age who are engaged in research and instruction at technical schools, universities and various publicly and privately supported institutions in the field of lubrication; or (2) persons not less than twenty-four years in age who have occupied recognized positions as Lubrication Engineers for a period of three or more (not necessarily consecutive) years prior to date of admission, involving the responsibility for or supervision of the development, selection, field use and application of lubricants as differentiated from other activities; or (3) persons not less than twenty-four years in age who are indirectly concerned with the field of lubrication, but possessing other qualifications of experience, knowledge and accomplishment, have manifested a particular interest in the purposes and welfare of the Society, to the extent that their membership would be a valuable contribution to the successful functioning of its activities.

JUNIOR MEMBERS
$5.00

Junior Members shall be: persons less than twenty-four years in age, and those who do not completely fulfill the membership requirements for Members.

INDUSTRIAL MEMBERS

Industrial members are such persons or organizations as may be interested in and desire to contribute to supporting the purposes and activities of the Society. The fees paid by an industrial member in general will not be allowed to exceed $200.00 per year.

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*Denotes Residence Address Preferred.

NEWS OF THE SECTIONS

(*Continued from page* 36)

PITTSBURGH

The regular monthly meeting was held at the Penn-Shady Hotel, Pittsburgh, Friday evening, December 12th. Forty-eight members and guests were present for dinner, Chairman Lykins presided.

Following the dinner, the annual election of officers was held, who were then in turn introduced to the members and guests present.

Mr. Johnson of the Standard Oil Company of Pennsylvania gave a short talk with a color moving picture on "Scenic Pennsylvania" which was followed by an informal discussion of football and comments on the outstanding players of the conference, accompanied by pictures.

The evening was concluded with refreshments and it was voted that this type of session be made an annual feature.

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CLEVELAND-YOUNGSTOWN

At the November meeting, members and guests heard Mr. J. E. Rosnell of the Technical Division of the Texas Company. Mr. Rosnell came from Chicago to deliver a talk on "The History of Grease-Development and Manufacture." The talk was of great interest to the members as was evidenced by the long question period which followed.

The next meeting of this Section will be held January 27th, and Mr. K. L. Schanbacher of the Carlisle Chemical Works will speak on "Cutting Oils, Their Constitution and General Classification."

The Section is very fortunate in being able to secure quarters for meetings at the Engineering Society quarters.

INDIANAPOLIS

The regular technical session of this Section was held January 5th at the Severin Hotel.

Mr. Edward C. Wahl of the Gits Brothers Company, Chicago, presented a very interesting discussion on the "Use and Misuse of Simple Oiling Devices." Mr. Wahl talked from his past experience and gave a very interesting discussion on various phases of Manual Lubrication.

The next meeting of the Section will be held on February 16th.

This Section is growing rapidly and extends a cordial invitation to all traveling members of the Society to attend their meetings.

MILWAUKEE

The first of a series of talks directly to plant management, plant engineers and master mechanics was held on the evening of January 26th at the Milwaukee Engineering Society.

The speaker's desk was occupied by Mr. Clyde A. Furgason, Chief Metallurgist of the Ladish Company. Mr. Furgason dwelt in detail on the various points that have been found beneficial to the company after the establishment of the planned lubrication program, quoting facts and figures and the general overall result of lower maintenance cost, increased production and lowering of actual lubrication costs.

This is the first of a series of educational programs that will be held by this Section and was enthusiastically received and commented on by the 60 members and guests present.

OILS AND LUBRICANTS PATENT ABSTRACTS

Printed copies of patents are available from the Patent Office at twenty-five cents each. Address the Commissioner of Patents, Washington, D. C., for copies and for general information concerning patents.

From Official Gazette—Vol. 603, Nos. 2, 3, 4; Vol. 604, Nos. 1, 2, 3, 4, 5.

Prepared by ANN BURCHICK

Petroleum Wax Coating Composition—Patent #2,429,150—John C. Zimmer and Ejnar W. Carlson, assignors to Standard Oil Development Co.

A coating composition comprising 10 to 70% paraffin wax, 20 to 80% petrolatum, and from 1% to 8% of a lead soap of saturated fatty acids of 12-24 carbon atoms.

Cutting Oil Composition—Patent #2,429,198—Louis H. Sudholz and Cecil D. Fleming, assignors to Socony-Vacuum Oil Co., Inc.

A sulfurized talloil cutting oil composition stable against the formation of sludge comprising a mineral oil lubricating fraction, a sulfurized talloil, and from about 5% to about 30% of a hydrocarbon oil having an aniline point of +40°F. or lower, a specific gravity of from 0.9 to 1.06, a flash point of 250°F. minimum, an initial boiling point of not less than 450°F., and a viscosity of not over about 200 seconds Saybolt Universal at 100°F.

Dehydration of Castor Oil—Patent #2,429,380—William T. Walton, Charles A. Coffey, and Oswald E. Knapp, assignors to The Sherwin-Williams Co.

The process of dehydrating castor oil to form a light colored drying oil, which includes the step of heating the castor oil to a temperature of about 190°C. to 290°C., with at least about 3% of a catalyst selected from the group consisting of 2-naphthol-8-sulfonic acid and 2-naphthol-6-sulfonic acid.

Wax-Oil Separation — Patent #2,429,430 — August Henry Schutte.

The method of separating an oil-wax mixture, comprising emulsifying said mixture with a non-solvent liquid having a freezing point above the pour point of the wax-free oil and having a crystal formation when frozen, and an oil-selective diluent in a liquid state, of greater specific gravity than the wax of the mixture and heavier than the frozen non-solvent and having a lower freezing point than the non-solvent chilling the resulting emulsion to freeze said non-solvent liquid and precipitate the wax in the emulsion while retaining the solution of oil and diluent in liquid state, centrifuging the emulsion so chilled to separate the wax from the solution of oil and diluent and form annular concentric strata including an inner stratum of separated wax and crystals of the frozen non-solvent, and an outer stratum comprising said solution, and maintaining said outer stratum relatively deep radially during the centrifuging step and thereby maintaining sufficient residence time of the materials within said centrifuging step for separation of the frozen non-solvent from the oil and diluent solution and combing of cloud-forming particles from the solution by the crystals of frozen non-solvent in the passage thereof radially inward from the solution.

Lubricating Oil Compositions Containing Wax Modifying Agents — Patent #2,429,479 — Louis A. Mikeska, assignor to Standard Oil Development Co.

A lubricating oil composition comprising a wax-containing mineral oil and an amount sufficient to substantially reduce the pour point but not in excess of 5% of a product obtained by reacting aromatic hydrocarbons with a material of the group consisting of formaldehyde and polymers thereof in the presence of sulfuric acid as a catalyst to produce a formaldehyde-cyclic resinous product, acylating the resultant product in the presence of a Friedel-Crafts catalyst with an acylating agent whose acyl groups contain at least 6 carbon atoms per molecule.

Lubricating, Rust-Dissolving, and Penetrating Oil—Patent #2,429,735—Henri Joan Vuyk.

A penetrating liquid of the character described for releasing "frozen" ferrous metallic screw-threaded joints and the like and consisting of an intimate admixture of carbon tetrachloride, acetic acid, gas-oil and a lubricating oil, in a proportion by volume of about 3:1:2:4.

Lubricant Composition—Patent #2,429,905—Wortley Andrew Wright, assignor to Sun Oil Co.

A lubricant composition adapted for use under service conditions in the presence of water to prevent rusting due to contact between metal and water which consists essentially of lubricating oil and 0.1%-2.0% of an oil soluble, water-insoluble, 1,2 dihydroxybenzene having an alkyl group attached to the benzene ring selecter from the group consisting of 4-tertiary butyl-1,2 benzene-diol; 4-tertiary octyl-1,2 benzenediol; 4-lauryl-1,2 benzenediol and 4-cyclohexyl-1,2 benzenediol.

Oil Base Drilling Fluid—Patent #2,430,039—Francis M. Anderson, assignor to Halliburton Oil Well Cementing Co.

A composition of matter for use in drilling wells comprising a thin grease made by mixing Diesel oil with an alkali metal tall oil soap to which saturated sodium chloride brine has been added in the amount of one-tenth per cent to one per cent by volume.

Mineral Oil Rustproofing Composition—Patent #2,430,058—Joseph H. Klaber, assignor to Quaker Chemical Products Corp.

A mineral oil rustproofing composition comprising a petroleum hydrocarbon vehicle containing a corrosion inhibiting amount of a mixture of a mono-ketone having a long alkyl chain and octyl alcohol, the alcohol being present in greater amount than the ketone.

Method of Forging and Lubricant Therefor—Patent #2,430,083—Donald W. Sherman, assignor to A. O. Smith Corp.

A method of forging comprising heating the work piece to be forged, and applying dies thereto under pressure to form the same in the presence of a ceramic enamel die lubricant.

Lubricating System—Patent #2,430,097—Walter C. Bauer, assignor, by mesne assignments, to The Briggs Filtration Co.

A system for lubricating internal combustion engines and other mechanism comprising an oil supply tank, a supply conduit connecting the tank and mechanism for conveying oil from the tank to the mechanism, a discharge conduit connecting the mechanism and tank for the discharge of oil from the mecchanism to the tank, a clarifier having an intake conduit connected to said supply conduit and an outlet conduit connected to said supply conduit at a point intermediate the mechanism and the point of connection of the intake conduit, means for circulating oil between the supply tank and mechanism and means independent of the circulating means and having a greater flow capacity than said circulating means for setting up a flow of oil through the clarifier at a higher rate than that at which the oil is circulated by said circulating means.

Lubricating and Cooling Compound for Cold Reducing Mills—Patent #2,430,400—Arnold P. Hoelscher, assignor to Carnegie-Illinois Steel Corp.

A method of lubricating and cooling the rolls of a cold metal rolling mill including the application to the surfaces of contact of the rolls and the metal workpiece of an oil-in-water type emulsion containing not more than 10% palm oil and between approximately 0.25% and approximately 1.0% of a water-soluble salt selected from the group of sodium, potassium and ammonium salts of phosphoric and boric acids which increases the lubricating properties of the mixture during the cold rolling without materially affecting its cooling efficiency.

Lubricant and Method of Producing Same—Patent #2,430,842—William S. Young, assignor to The Atlantic Refining Co.

A lubricant produced by heating a mixture of 1 mole of an aliphatic hydroxy polycarboxylic acid of not more than 6 carbon atoms with 1 to 2 moles of a glycol at 150°C. to 200°C. to condense said reactants to a fluid resinous product, and incorporating with said reactants from 1% to 10% by weight of an aluminum soap of a fatty acid containing 12 to 18 carbon atoms subsequent to the initiation of the condensation reaction but prior to the completion thereof.

Foam Inhibited Oil—Patent #2,430,857—Victor N. Borsoff and James O. Clayton, assignors, by mesne assignment, to California Research Corp.

A foam inhibited mineral oil, comprising a major quantity of an excessively foaming mineral oil of lubricating viscosity, and a minor quantity, sufficient to inhibit foaming, of a compound which contains not less than about 15 per cent by weight of oxygen, has a molecular weight not higher than about 270, and is represented by the formula $A(X)_a(OR)_b$ wherein A is an aromatic nucleus, X is an oxygen-containing substituent, R is a member of the class consisting of hydrogen, alkyl, cycloalkyl, aryl and aralkyl radical, and a and b are integers.

Foam Inhibited Oil—Patent #2,430,858—Victor N. Borsoff and James O. Clayton, assignors, by mesne assignments, to California Research Corp.

A compounded hydrocarbon lubricating oil comprising a major proportion of the hydrocarbon oil of lubricating viscosity, a small amount of a metal salt selected from the group consisting of oil-soluble metal salts of organic acids and oil-soluble metal salts of organo-substituted inorganic acids, said salt being present in amounts sufficient to increase substantially the tendency of the oil to foam when subjected to agitation with air, and a small amount, sufficient substantially to inhibit foaming of the oil when subjected to agitation with air, of an aliphatic compound consisting of elements selected from the group consisting of carbon, hydrogen, oxygen and nitrogen, having a molecular weight not greater than about 225, containing at least two oxygen atoms in the molecule and containing not less than about 25% by weight of oxygen.

Cooling Fluid—Patent #2,431,008 — Donald L. Wright, assignor to Standard Oil Development Co.

The method of carrying out high speed grinding operations in which an abrading wheel rotates at high speed against metal stock which comprises applying to the metal at the point of abrasion a viscous lubricant comprising a major portion of a non-toxic, non-corrosive volatile, relatively low viscosity petroleum hydrocarbon liquid, a substantial proportion of which is vaporizable by the heat of abrasion, and a minor portion up to about 20% by weight of an aliphatic polymeric thickener adapted to decompose at elevated temperatures without leaving any substantial residue, said thickener being a high molecular weight viscosity-increasing polymer having an average molecular weight of not less than 800.

Soluble Cutting Oil—Patent #2,431,010—John C. Zimmer, assignor to Standard Oil Development Co.

Soluble cutting oil comprising a mineral lubricating oil, an emulsifier capable of emulsifying water and oil and an alkyl xanthogen polysulfide having from 1 to 4 carbon atoms in the alkyl group having dissolved therein excess elemental sulfur.

Corrosive Inhibited Additive for Mineral Lubricating Oil Composition—Patent #2,431,011—John C. Zimmer and George M. McNulty, assignors to Standard Oil Development Co.

A composition suitable for increasing the load carrying capacity of a mineral lubricating oil which consists essentially of an oil-soluble halogen containing compound of a kind which will substantially increase the load carrying capacity of the lubricant to which it is added but which tends to form a hydrohalogenic acid in the presence of said oil, and a minor proportion, sufficient to reduce corrosion, of an oil-soluble salt of an autocondensation product of a hydroxyarylalkyl amine, said amine having alkyl groups which contain a total of at least four carbon atoms per molecule.

Stabilizing Glyceride Oils—Patent #2,431,347 — Albert Scharf, assignor to American Lecithin Co.

The method of stabilizing cottonseed oil against oxidation which comprises heating the oil to a temperature of about 400°F. and adding up to 1% of phosphatide to the oil at a temperature not exceeding 300°F. substantially immediately after the cooling.

Lubricant Manufacture—Patent #2,431,453—Alan Beerbower and John C. Zimmer, assignors to Standard Oil Development Co.

Process for manufacturing a grease which comprises mixing a soap and a mineral base lubricating oil at a temperature substantially below the temperature at which said soap blends with said oil to form a grease, said temperature being above room temperature and not over 150°F. to thereby form a slurry of soap and oil, diluting said slurry with additional oil, preheated with all the heat required for the grease cooking, and blending to give the proportions of soap and oil desired in the finished grease, and cooling the resultant grease stock at least to a grease structure-forming temperature.

Sulphur-Containing Phosphatide, Lubricant, and Method of Making—Patent #2,431,652—Edward Trueger, assignor to American Lecithin Co.

The process for treating phosphatides for use as additives to a lubricant containing a mineral oil to inhibit the formation of naphtha insolubles therein which comprises the steps of treating a vegetable phosphatide with an approximately .2N solution of thiocyanogen in benzene at room temperature, and removing the benzene after formation of the resulting sulffur-containing phosphatide compound.

A mineral lubricating composition comprising a mineral oil and between about .1% and about 15% of a product prepared by reacting a crude vegetable phosphatide with thiocyanogen at room temperature.

Process of Controlling Lubricating Emulsions—Patent #2,431,657—Judson A. De Cew.

A method of making lubricating emulsions which comprises forming an aqueous compound of an emulsified lubricant and an emulsifying agent that is soluble in the lubricant and in the water, atomizing such compound into hot water to form a solution therewith while controlling the proportion of emulsifying agent used in the compound to be substantially the minimum for yielding

such a solution by such atomization, discharging such solution into cold water, wherein due to dilution and change of temperature, particles of the lubricant pass from solution phase to emulsion phase wherein they are in suspension and a majority of which are small enough to exhibit the Brownian movement, stabilizing the emulsion for minimizing coalescence of the lubricating particles, and adjusting the pH of the emulsion until the negative charges of the lubricating particles overbalance the positive charges of the emulsifying agent in the solution on the basis of lowering the pH to reduce deposited potential.

Noncorrosive Lubricating Composition — Patent #2,431,737—Gifford D. Davis and Edwin J. Barth, assignors to Nopco Chemical Co.

A noncorrosive lubricating composition, the essential constituents of which consist of a mineral lubricating oil and sulfurized glyceryl esters of tall oil, the mineral oil constituting the major portion of the composition and said sulfurized glyceryl esters of tall oil being present in an amount sufficient to impart extreme pressure properties to the composition.

Aluminum Base Greases—Patent #2,431,760—Francis Joseph Licata, assignor to Nopco Chemical Co.

A lubricating grease comprising mineral oil, 2% to 20% of an aluminum soap of a saturated higher fatty acid and 0.1% to 5.0% of a lithium soap of a higher fatty acid, the quantity of lithium soap being only a fraction of that of the aluminum soap present.

Method of Producing Nonsiccative Rosin Oils—Patent #2,431,788—Roger Septime Auguste Collonges and Jean Philippe Simon Vallee, assignors to "Chimiotechnic" Union Chimique du Nord et du Rhone.

A method for producing from rosin a nonsiccastive oily composition of matter, consisting of decarboxylating and partly dehydrohenating the resin at a temperature from about 200° to 300°C. with 1% of sulphur, and ferric oxide in presence of air and purifying the product by distilling the same.

Treatment of Petroleum Oils—Patent #2,431,792—Nicholas J. Datesh and John N. Datesh.

A composition for demulsifying petroleum oils and removing and preventing sludge formation therein, consisting of about 3 parts by weight of phenol, about 8 parts by weight of cresylic acid, about 3 parts by weight of benzol, about 75 parts by weight of tar acid oil, about 1 part by weight of ammonium linoleate, about 3 parts by weight of alcohol, and about 7 parts by weight of ethylene dichloride.

Lubricating Composition—Patent #2,432,095—Delton R. Frey.

A lubricating composition comprising principally a liquid hydrocarbon of the character which is normally subject to deterioration especially at high temperatures and when in contact with metals, and which has been stabilized against such deterioration by the inclusion therein of a minor amount, sufficient to effect such stabilization, of a mixture phosphorus-containing compounds, which mixture consists of at least a part of the reaction product of (a) a trivalent phosphorus-and-halogen-containing reagent containing an organic radicle selected from the class consisting of aromatic and aliphatic radicles with (b) a cycloaliphatic compound containing the —X—H group where X is an element selected from the class consisting of oxygen and sulphur, said reaction product prepared by mixing the reactants and exposing the mixture to reaction conditions which produce the primary reaction product without any substantial decomposition of such primary reaction product.

Manufacture of Lubricating Oil—Patent #2,432,440—John A. Patterson, assignor to The Texas Company.

In the manufacture of lubricating oil of superior oxidation stability adapted for turbine oil, the process that comprises first subjecting a distillate petroleum lubricating stock to acid treating and solvent refining to produce a highly refined oil, then treating the highly refined oil with about 1-2% by weight of sulfur at a temperature within the range of 300-450°F. for a period of about 1-2 hours to thereby effect reactions producing increased oxidation stability and finally treating the oil with an alkaline solution of sodium sulfide to effect removal of free sulffur without impairing the oxidation stability of the product.

Lubricating and Cooling Compound for Cold Reducing Mills — Patent #2,432,784 — Harold F. Miller and Samuel J. Moore.

A lubricating and cooling compound for cold reduction mills consisting of the following ingredients in per cent by weight: 0.5 to 10% saponifiable oil containing free fatty acid or acids, 0.05 to 2.0% water soluble inorganic salt yielding free base by hydrolysis and forming a soluble soap with the oil, 0.05 to 2.0% aliphatic organic hydroxy-acid having a low dissociation constant, the remainder being substantially all water.

Petroleum Oil Compositions—Patent #2,432,806—Albert G. Rocchini and Charles Byron Pattinson, Jr., assignors to Gulf Research and Development Co.

A mineral oil composition comprising a major amount of a petroleum lubricating oil and a small amount of ortho-ethylphenol sufficient to retard halogenation of said petroleum lubricating oil.

Petroleum Oil Compositions—Patent #2,432,807—Albert G. Rocchini and Charles Byron Pattinson, Jr., assignors to Gulf Research and Development Co.

A mineral oil composition comprising a major amount of a petroleum lubricating oil and a small amount of ortho-cyclohexylphenol sufficient to retard halogenation of said petroleum lubricating oil.

Rust Inhibiting Oil Composition—Patent #2,432,901—Sven Christian Johansson.

A rust inhibiting oil composition comprising an oil, an alkali metal salt of a nitrophenol normally insoluble in the oil and a solvent of the group consisting of amylalcohol and amylacetate for solubilizing the alkali metal salt, the said alkali metal salt of nitrophenol being present in an amount sufficient to inhibit corrosion by the oil.

Process for the Preparation of Siccative Oils—Patent #2,433,077—Maurict Dussollier, assignor to Etablissements Robbe Freres.

A process for the preparation of drying oils comprising heating castor oil to a temperature between 140°C. and 280°C., and passing a stream of sulfur dioxide gas through the heated oil whereby the oil is agitated and catalytically dehydrated.

Diesel Fuel Oils—Patent #2,433,243—Herschel G. Smith and Troy L. Cantrell and John G. Peters, assignors to Gulf Oil Corp.

An improved Diesel fuel oil which contains a small proportion of an aliphatic amine soap made from a long chain primary aliphatic amine that has at least 10 carbon atoms and a long chain aliphatic monocarboxylic acid that has at least 10 carbon atoms and which also contains a small proportion of a polyvalent metal salt of an N-alkenyl phthalamidic acid, said aliphatic amine soap and polyvalent metal salt being present in sufficient quantities to retard corrosion, wear, gum formation and ring sticking in a Diesel engine burning said Diesel fuel oil.

Manufactnre of Greases—Patent #2,433,636—Benjamin H. Thurman, assignor, by mesne assignments, to Benjamin Clayton, doing business as Refining Unincorporated.

The process of making grease containing lubricating oil and a soap, which comprises, heating a stream of a suspension in water of an insoluble polyvalent metal soap to a temperature above the melting point of said soap, rapidly passing said stream through a vapor separating chamber and therein removing said water by vaporization while maintaining a temperature above said melting point to produce a stream of molten substantially anhydrous soap, mixing a lubricating oil with said molten anhydrous soap in a closed mixing zone to prevent loss of oil by vaporization and rapidly cooling a stream of the resulting mixture while out of contact with the atmosphere to a temperature below that at which said soap and oil will be damaged by contact with the atmosphere.

Soluble Oil and Process of Producing Same—Patent #2,433,646—Philip L. Carter and Walter J. Coppock, assignors to Sun Oil Co.

The process of making a soluble oil which comprises treating a mixture of naphthenic acids and untreated lubricating oil with a sulfonating agent under sulfonating conditions to form a sulfonated stock and neutralizing the thus formed stock with an alkali metal hydroxide thereby to form the soluble oil.

Iesel Fuel Oils—Patent #2,433,716—Herschel G. Smith and Troy L. Cantrell and Mark L. Hill, assignors to Gulf Oil Corp.

An improved iesel fuel oil which contains a small proportion of an aliphatic amine soap made from a long chain primary aliphatic amine that has at least 10 carbon atoms and a long chain aliphatic monocarboxylic acid that has at least 10 carbon atoms and which also contains a small proportion of a salt selected from the group consisting of divalent and trivalent metal salts of an N-alkenyl, N-alkylol phthalamidic acid, said aliphatic amine soap and polyvalent metal salt being present in sufficient quantities to retard corrosion, wear, gum formation and ring sticking in a Diesel engine burning said iesel fuel oil.

Manufacture of Lubricating Oil—Patent #2,433,797—Fred C. Toettcher, assignor to The Texas Company.

In the manufacture of lubricating oil of superior oxidation stability the process that comprises first subjecting the raw lubricating stock obtained from crude petroleum to refining treatment involving acid treating and solvent refining and then contacting the refined lubricating oil with a composite of molybdenum oxide and alumina at a temperature within the range of 650-750°F. to thereby effect reactions causing increased oxidation stability.

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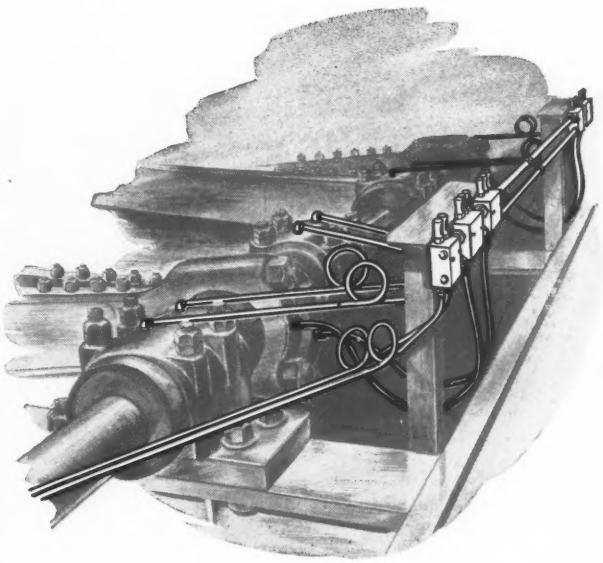

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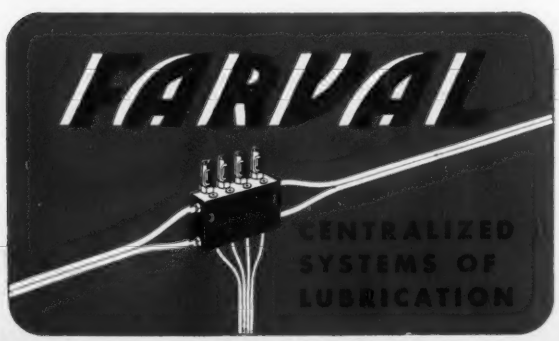

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